CIRCULAR DEQ 4

MONTANA STANDARDS

FOR SUBSURFACE WASTEWATER

TREATMENT SYSTEMS

~~2009~~ 2012 Edition

FOREWORD

These standards, based on proven technology, set forth requirements for the design and preparation of plans and specifications for subsurface wastewater treatment systems.

Users of these standards need to be aware that subsurface wastewater treatment systems are considered by the Environmental Protection Agency to be Class V injection wells and may require associated permits. Of particular concern are systems receiving wastewater from industries and automotive service stations.

These standards are a revision of the Department's Circulars WQB-4, WQB-5, and WQB-6, 1992 Editions and Circular DEQ 4, 2000, 2002, ~~and~~, 2004, and 2009 Editions.

CIRCULAR DEQ-4

CHAPTER

1. INTRODUCTION

1.1 APPLICABILITY

1.1.1 General

These minimum standards apply to all subsurface wastewater treatment systems in Montana. In some cases, a reviewing authority (other than the Department of Environmental Quality) may have requirements that are more stringent than those set out in this Circular.

The term "reviewing authority," as used in these standards, refers to the Montana Department of Environmental Quality, a division of local government delegated to review public wastewater systems pursuant to Administrative Record of Montana (ARM) 17.38.102, a local unit of government that has adopted these standards pursuant to Section 76-3-504, Montana Code Annotated (MCA), or a local board of health that has adopted these standards pursuant to Section 50-2-116, MCA.

1.1.2 Types of systems

This Circular describes different types of wastewater treatment and disposal systems for use in subsurface effluent discharge. These systems typically consist of a collection system, septic tank, distribution box or manifold and series of subsurface laterals for effluent allocation. All wastewater applied to the subsurface treatment system must meet residential strength parameters. The method and pattern of effluent discharge in a subsurface absorption system are important design elements; distribution of effluent may be either through gravity flow application or pressure dosing.

The gravity flow method of effluent distribution discharges wastewater from the septic tank or other pretreatment tank directly to the subsurface treatment system as incoming wastewater displaces it from the tank(s). It is characterized by the term "trickle flow" because the effluent is slowly discharged over much of the day. Typically, tank discharges are too low to flow throughout the entire subsurface network; thus, distribution is unequal and localized. Overloading of the infiltration surface may occur; without extended periods of little or no flow to allow the subsoil to dry, hydraulic failure is possible.

Pressure dose distribution accumulates wastewater effluent in a dose tank from which it is periodically discharged under pressure to the subsurface treatment system by a pump. The pretreated wastewater is allowed to accumulate in the dose tank and is discharged "in doses" when a predetermined water level, water volume, or elapsed time is reached. The dose volumes and discharge rates are usually such that much of the subsurface network is filled, resulting in more uniform distribution over the absorption system area. Periods between doses provide opportunities for the subsoil to drain and reaerate before the next dose. As a result, dosed-flow systems reduce the rate of soil clogging, more effectively maintain unsaturated conditions in the subsoil and provide a means to manage wastewater effluent applications to the absorption system. Dosing outperforms gravity-flow systems because distribution is more uniform, controlled and can be used in any application. Pressure dosed distribution should be the method of choice whenever possible. Specific requirements relating to pressure dosed absorption system designs are addressed in Chapter 4.3.

The~~se~~ wastewater treatment and disposal systems described by this document include standard absorption trenches, shallow capped absorption trenches, deep absorption trenches, ~~at-grade absorption trenches~~, sand-lined absorption trenches, gravelless trenches and other absorption systems, elevated sand mounds, intermittent sand filters, recirculating sand filters, recirculating trickling filters, evapotranspiration absorption systems, evapotranspiration systems, aerobic wastewater treatment units, chemical nutrient reduction systems, waste segregation systems, subsurface drip systems, gray water systems, and experimental systems. ~~Systems providing advanced treatment or greater separation to a limiting layer may be used where standard absorption trenches are acceptable~~. ~~Many of these systems also have specific applications to solving particular problems.~~ ~~The list~~ Below is a partial list of system applications intended to assist in problem solving for a particular set of site conditions.

1.1.3 System uses

1.1.3.1 Deep absorption trenches are used to break through an impervious soil layer and allow effluent to infiltrate a deeper and more permeable soil. ~~The bottom of the trench must not be more than 5 feet below natural ground surface.~~

1.1.3.2 Shallow capped absorption trenches and elevated sand mounds are used to achieve the minimum separation distance between the ~~bottom of the trench~~ treatment system and a limiting layer. ~~and may be used as long as a 4-foot separation can be maintained. These systems may be used only for residential strength wastewater and for flows not exceeding 500 gallons per day~~.

1.1.3.3 ~~Sand-lined absorption trenches are used where the percolation rate is faster than 3 minutes per inch or for rapid or slow permeability situations~~. Sand-lined absorption trenches are used for rapid permeability situations.

1.1.3.4 Gravelless trenches and other absorption systems are used in lieu of standard absorption trenches within the limitations provided in this Circular.

~~Elevated sand mounds are used to provide advanced treatment of septic tank effluent and/or to achieve the minimum separation distance between the bottom of the drain rock and a limiting layer.~~

1.1.3.5 Evapotranspiration absorption systems are used where slow percolation rates or soil conditions would preclude the use of a standard absorption trench.

1.1.3.6 Evapotranspiration systems are used where slow percolation rates or soil conditions would preclude the use of a soil absorption ~~standard~~ system

1.1.3.7 Subsurface drip systems are used for irrigation and in cases where the standard absorption system shape must be altered due to topography or natural barriers.

1.1.3.8 Gray water systems are used for irrigation.

1.1.3.9 Intermittent sand filters are used to provide advanced treatment of septic tank effluent prior to final disposal and are typically used on small systems.

1.1.3.10 Recirculating sand filters are used to provide advanced treatment of septic tank effluent prior to final disposal and are typically used on large wastewater systems.

1.1.3.11 Recirculating media trickling filters and chemical nutrient reduction systems are used to provide advanced treatment of septic tank effluent prior to final disposal.

1.1.3.12 Aerobic wastewater treatment units are used to provide advanced treatment of septic tank effluent or to provide treatment equal to or better than a septic tank prior to final disposal. They may also be used to provide treatment of high strength wastewater.

~~Chemical nutrient reduction systems are used to provide advanced treatment of septic tank effluent. The monitoring frequency must be sufficient to establish the treatment efficiency and response to varying wastewater flows, strengths, and climatic conditions. The Department will consider the complexity and maintenance required of the system, the stability of the processes, and the monitoring data in determining the adequacy, level of maintenance, and monitoring frequency of the system.~~

1.1.3.13 Absorption beds, holding tanks, sealed pit privies, unsealed pit privies, and seepage pits may only be used as specified in ~~Department~~ the reviewing authority's regulations. These systems are not allowed as new systems in subdivisions unless authorized by the regulations. Typically, these systems are subject to limited areas, used as replacement systems, or are used in areas where other systems cannot be used.

1.1.3.14 Waste segregation systems are used where system utilization, slow percolation rates or soil conditions would preclude the use of a soil absorption system

1.1.3.15 ~~Gray water is untreated wastewater collected from bath tubs, showers, lavatory sinks, clothes washing machines, and laundry tubs. Gray water systems used in conjunction with a waste segregation system may also use wastewater collected from kitchens. Gray water can be contaminated with organic matter, suspended solids or microorganisms that are potentially pathogenic. In general, treatment and disposal of gray water is subject to all applicable provisions in this Circular, except that gray water may be used for irrigation as provided in this chapter.~~

1.1.4 Deviations

~~Deviations from the mandatory requirements of this Circular may be granted by the reviewing authority having jurisdiction on a case-by-case basis for specific projects~~. The reviewing authority may grant deviations from the requirements of this Circular. The terms **shall, must,** and **may not** are used where practice is sufficiently standardized to permit specific delineation of requirements or where safeguarding of the public health justifies such definite action. These mandatory items serve as a checklist for the reviewing authority. Other terms, such as **should, may, recommended,** and **preferred**, indicate desirable procedures or methods. These non-mandatory items serve as guidelines for designers and do not require specific deviations.

1.1.4.1 Procedure

A person desiring a deviation shall make a request in writing to the reviewing authority having jurisdiction and shall include the appropriate review fee. The request must identify the specific section of the Circular to be considered. Adequate justification for the deviation must be provided. “Engineering judgment” or “professional opinion” without supporting data ~~must be~~ is considered inadequate justification. The justification must address the following issues:

A. The system that would be allowed by the deviation would be unlikely to cause pollution of state waters in violation of 75-5-605, MCA; and

B. The granting of the deviation would protect the quality and potability of water for public water supplies and domestic uses and would protect the quality of water for other beneficial uses, including those uses specified in 76-4-101, MCA; and

C. The granting of the deviation would not adversely affect public health, safety, and welfare.

The reviewing authority having jurisdiction will review the request and make final determination on whether a deviation may be granted.

The reviewing authority ~~must~~ shall maintain a file of all deviations.

~~A file of all deviations must be maintained by the reviewing authority~~.

1.1.5 Illustrations and Examples

The images, pictures examples and calculations found in this Circular are presented for illustration purposes only and may not include all design requirements. Please refer to the specific rules pertaining to each element for details.

1.2 DEFINITIONS

2.1.1.1 **Absorption area** means that area determined by multiplying the length and width of the bottom area of the disposal trench.

2.1.1.2 **Absorption bed** means an absorption system that consists of excavations greater than 3 feet in width where the distribution system is laid for the purpose of distributing pretreated waste effluent into the ground.

2.1.1.3 **Absorption system** means any secondary treatment system including absorption trenches, elevated sand mounds, ~~and~~ evapotranspiration absorption (ETA) ~~systems~~, gray water irrigation and subsurface drip systems used for subsurface disposal of pretreated waste effluent.

2.1.1.4 **Absorption trench** means an absorption system that consists of excavations 18 to 36 inches ~~less than or equal to 3 feet~~ in width where the distribution system is laid for the purpose of distributing pretreated waste effluent into the ground.

2.1.1.5 **Accessory building** means a subordinate building or structure on the same lot as the main building, which is under the same ownership as the main building, and which is devoted exclusively to an accessory use such as a garage, workshop, art studio, guest house, or church rectory.

2.1.1.6 **Advanced treatment** means a treatment process that provides effluent quality in excess of primary treatment.

2.1.1.7 **Aerobic wastewater treatment unit** means a wastewater treatment plant that incorporates a means of introducing air and oxygen into the wastewater so as to provide aerobic biochemical stabilization during detention period. Aerobic wastewater treatment facilities may include anaerobic processes as part of the treatment system.

2.1.1.8 ~~**Bedrock** means material that cannot be readily excavated by hand tools, or material that does not allow water to pass through or that has insufficient quantities of fines to provide for the adequate treatment and disposal of wastewater~~.
Bedrock means material that cannot be readily excavated by hand tools, or material that does not allow water to pass through or that has insufficient quantities of fines to provide for the adequate treatment and disposal of wastewater.

2.1.1.9 **Bedroom** means any room that is or may be used for sleeping on a regular basis. An unfinished basement is considered as an additional bedroom.

2.1.1.10 **Blackwater** means any wastewater that includes waste from toilets**.**

2.1.1.11 **BOD_5** (five-day biochemical oxygen demand) means the quantity of oxygen used in the biochemical oxidation of organic matter in 5 days at 20 degrees centigrade under specified conditions and reported as milligrams per liter (mg/L).

2.1.1.12 **Building drain** means the pipe extending from the interior plumbing to a point 2 feet outside the foundation wall.

2.1.1.13 **Building sewer** means the pipe connecting the house or building drain to the public sewer or private sewer.

2.1.1.14 **Cleanout** means access to a sewer line ~~at least~~ ~~4 inches diameter~~, extending from the sewer line to the ground surface or inside the foundation, used for access to clean a sewer line.

~~**Chemical nutrient reduction** means a wastewater treatment system that incorporates the systematic addition of one or more chemicals into the effluent in order to reduce the concentration of one or more chemical components (such as nitrate or phosphorus).~~

2.1.1.15 **Commercial unit** means the area under one roof occupied by a business. For example, a building housing two businesses under one roof is considered two commercial units.

2.1.1.16 **Composting toilet** means a system consisting of a compartment or a vault that contains or will receive composting materials sufficient to reduce human waste by aerobic decomposition.

2.1.1.17 **Connection** means a line that provides water or sewer service to a single building or main building with accessory buildings. The term is synonymous with "service connection".

2.1.1.18 **Design flow** means the ~~peak~~ flow ~~(daily or instantaneous, as appropriate)~~ used for sizing hydraulic facilities, such as pumps, piping, storage, and absorption systems ~~and means the average daily flow for sizing other treatment systems.~~

2.1.1.19 **Distribution box** means a watertight receptacle that receives septic tank effluent and distributes it equally into two or more pipes leading to the absorption area.

2.1.1.20 **Distribution pipe** means a perforated pipe used in the dispersion of septic tank or other treatment facility effluent into ~~disposal trenches, seepage trenches, or seepage beds~~ a subsurface wastewater treatment system.

2.1.1.21 **Dosed system** means any system that utilizes a pump or actuated valves to deliver treated effluent to a subsurface absorption area.

2.1.1.22 **Dosing frequency** means the number of times per day that effluent is applied to an absorption system, ~~drainfield,~~ or sand filter~~, or sand mound, or to a section of an absorption system, drainfield, sand filter, or sand mound.~~

2.1.1.23 **Dosing tank** means a watertight receptacle receiving effluent from the septic tank or after another treatment device, equipped with ~~an automatic~~ ~~siphon or~~ a pump designed to discharge effluent.

2.1.1.24 **Dosing volume** means the volume of effluent (in gallons) applied to an absorption system~~, drainfield~~ or sand filter~~, or sand mound~~ each time a pump is activated. ~~turned on~~ ~~or each time a siphon functions.~~

2.1.1.25 **Drain rock** means the rock or coarse aggregate used in an absorption system~~, drainfield, sand mound,~~ or sand filter. Drain rock must be washed, be a maximum of 2 ½ inches in diameter and larger than the orifice size unless shielding is provided to protect the orifice, and contain no more than 2 percent passing the No. 8 sieve. The material must be of sufficient competency to resist slaking or dissolution. Gravels of shale, sandstone, or limestone may degrade and may not be used.

~~**Dwelling or residence** means any structure, building, or portion thereof, which is intended or designed for human occupancy and supplied with water by a piped water system.~~

2.1.1.26 **Effective size** means the sieve size in millimeters (mm) allowing only 10 percent of the material to pass as determined by wet-test sieve analysis method ASTM C117-95.

2.1.1.27 **Effluent** means partially treated wastewater from a ~~septic tank~~ primary, advanced or other treatment facility.

2.1.1.28 **Effluent filter** means an effluent treatment device installed on the outlet of a septic tank designed to prevent the passage of suspended matter larger than 1/8 inch in size.

2.1.1.29 **Effluent pump** means a pump used to convey wastewater that has been partially treated from a septic tank or other treatment facility. This wastewater has had settleable or floatable solids removed.

2.1.1.30 **Ejector pump** means a pump that transports raw sewage.

2.1.1.31 **Emitter** means orifices that discharge effluent at slow, controlled rates, usually specified in gallons per hour. Emitters are typically found in subsurface drip irrigation systems.

2.1.1.32 **Escarpmen**t means any slope greater than 50 percent, which extends vertically 6 feet or more as measured from toe to top.

2.1.1.33 **Fats, oils, grease (FOG)** means a component of wastewater typically originating from food stuffs (animal fats or vegetable oils) or consisting of compounds of alcohol or glycerol with fatty acids (soaps and lotions).

2.1.1.34 **Fill** means artificially placed soil.

2.1.1.35 **Gravity dose** means a known volume (dose) of effluent that is delivered to an absorption system in a specific time interval. The effluent ~~may be~~ is delivered ~~either by a siphon or~~ by a pump to a drop box, distribution box or manifold. The drop box distribution box or manifold then distributes effluent into a non-pressurized absorption system.

2.1.1.36 **Gray Water** means wastewater that is collected separately from a sewage flow and that does not contain industrial chemicals, hazardous wastes, or wastewater from toilets.

2.1.1.37 **Grease trap** means a device designed to separate fats, grease and oils from the effluent.

2.1.1.38 **Grinder pump** means a pump that shreds solids and conveys wastewater through a sewer to primary or advanced treatment.

2.1.1.39 **High-strength waste** means effluent from a septic tank or other treatment device that has BOD_5 greater than 300 mg/L, ~~and/or~~ TSS greater than 150mg/L, ~~and~~/or fats, oils, and grease greater than 25mg/L.

2.1.1.40 **Holding tank** means a watertight receptacle that receives wastewater for retention and does not as part of its normal operation dispose of or treat the wastewater**.**

2.1.1.41 **Horizon** means a layer in a soil profile that can be distinguished from each of the layers directly above and beneath it by having distinctly different soil physical, chemical, and/or biological characteristics.

2.1.1.42 **Impervious layer** means any layer of material in the soil profile that has a percolation rate slower than 240 ~~120~~ minutes per inch.

2.1.1.43 **Incinerating toilet** means a self-contained unit consisting of a holding tank and an adequate heating system to incinerate waste products deposited in the holding tank. The incineration by-products are primarily water and a fine ash.

~~structure. The total number of people served may not exceed 24.~~

2.1.1.44 **Individual wastewater system** means a wastewater system that serves one living unit or commercial unit. The term does not include a public sewage system as defined in 75-6-102, MCA

2.1.1.45 **Industrial wastewater** means any waste from the process of business or industry or from the development of any natural resource, together with any sewage that may be present~~.~~

2.1.1.46 **Infiltrative surface** means the soil interface that receives the effluent wastewater below the drain rock or sand.

2.1.1.47 **Influent** means the wastewater flow stream prior to any t~~reat~~ment.

2.1.1.48 **Irrigation** means those ~~– irrigation~~ systems ~~are those~~ that provide ~~for the~~ subsurface application of wastewater to any planted material by means of a piping system.

2.1.1.49 **Key** means to hollow out in the form of a groove.

2.1.1.50 **Limiting layer** means bedrock, an impervious layer or seasonally high ground water.

2.1.1.51 **Living unit** means the area under one roof that can be used for one residential unit, and which has toilet facilities, a kitchen, a bedroom, and an independent entrance. A duplex is considered two living units.

2.1.1.52 **Manhole mean**s an access to a sewer line for cleaning or repair. ~~with requirements as defined in Department DEQ-2 1999 Edition.~~

2.1.1.53 **Main** means any line providing water or sewer to multiple service connections, any line serving a water hydrant that is designed for firefighting purposes, or any line that is designed to water or sewer main specifications.

2.1.1.54 **Manifold** means a solid (non-perforated) main wastewaer line that distributes effluent to individual distribution pipes.

2.1.1.55 **Mottling** or **redoximorphic features** means soil properties associated with wetness that result from the reduction and oxidation of iron and manganese compounds in the soil after saturation and desaturation with water.

2.1.1.56 **Multiple-user wastewater system** means a non-public wastewater system that serves or is intended to serve ~~three through 14 living units or three through 14 commercial structures~~ more than two living or commercial units, but which is not a public sewage system as defined in 75-6-102, MCA. The total number of people served may not exceed 24. In estimating the population that will be served by a proposed residential system, the reviewing authority shall multiply the number of living units times the county average of persons per living unit based on the most recent census data 2.5.

2.1.1.57 **Natural soil** means soil that has developed in place through natural processes, and to which no fill material has been added.

2.1.1.58 **Orifice means** an opening or hole through which wastewater can exit the distribution pipe**.**

~~**Passive nutrient reduction** means a wastewater treatment system, other than elevated sand mound, intermittent sand filter, or recirculating sand filter, that reduces the effluent concentration of one or more components (such as nitrate or phosphorus) without the addition of chemicals and without mechanical aeration.~~

2.1.1.59 **Percolation test** means a standardized test used to assess the infiltration rate of soils performed in accordance with Appendix A.

2.1.1.60 **Plasticity** means the ability of a soil sample to be rolled into a wire shape with a diameter of 3 mm without crumbling.

2.1.1.61 **Pressure distribution** means an effluent distribution system where all pipes are pressurized~~, the head at any orifice is at least 1 pound per square inch (psi) and not more than 6 psi,~~ and the effluent is pumped (~~or delivered by siphon~~) to the next portion of the treatment system in a specific time interval or volume.

2.1.1.62 **Pretreatment** means the wastewater treatment that takes place prior to discharging to any component of a wastewater treatment and disposal system, including, but not limited to, pH adjustment, oil and grease removal, BOD_5 and TSS reduction, screening, and detoxification.

2.1.1.63 **Primary treatment** means a treatment system, such as a septic tank, that provides retention time to settle the solids in raw wastewater and that retains scum within the system

2.1.1.64 **Private sewer** means a sewer receiving the discharge from one building sewer and conveying it to the public sewer system or a wastewater treatment system.

2.1.1.65 **Professional engineer** means an engineer licensed or otherwise authorized to practice engineering in Montana pursuant to Title 37, Chapter 67, MCA.

2.1.1.66 **Proprietary system** means a wastewater treatment method holding a patent, or trademark

2.1.1.67 **Public wastewater system** means a system for collection, transportation, treatment, or disposal of wastewater that serves 15 or more families or 25 or more persons daily for a period of at least any 60 or more days in a calendar year. In estimating the population that will be served by a proposed residential system, the reviewing authority shall multiply the number of living units times the county average of persons per living unit based on the most recent census data of 2.5, so that 10 or more proposed residential connections will be considered a public system.

2.1.1.68 **Raw wastewater** means wastewater that has not had settleable solids removed through primary treatment or other approved methods.

2.1.1.69 **Recreational camping vehicle** means a vehicular unit designed primarily as temporary living quarters for recreational, camping, travel, or seasonal use, and that either has its own power or is mounted on, or towed by, another vehicle. The basic types of RVs are: camping trailer, fifth wheel trailer, motor home, park trailer, travel trailer, and truck camper

2.1.1.70 **Redoximorphic** or mottling features means soil properties associated with wetness that result from the reduction and oxidation of iron and manganese compounds in the soil after saturation and desaturation with water.

2.1.1.71 **Residential strength wastewater** means effluent from a septic tank or other treatment device with a BOD_5 less than or equal to 300 mg/L, TSS less than or equal to 150 mg/L, and fats, oils, and grease less than or equal to 25 mg/L.

2.1.1.72 **Reviewing authority** means the Department of Environmental Quality, a local department or board of health certified to conduct reviews under 76-4-104, MCA; a division of local government delegated to review public wastewater systems pursuant to ARM 17.38.102; a local unit of government that has adopted these standards pursuant to 76-3-504, MCA; or a local board of health that has adopted these standards pursuant to 50-2-116, MCA.

2.1.1.73 **Scarify** means to make shallow cuts in order to break the surface.

~~**Secondary treatment** means a biological treatment process coupled with solid/liquid separation. The effluent from secondary treatment should generally have a BOD_5 less than 30 mg/L and TSS less than 30 mg/L.~~

2.1.1.74 **Seasonally high ground water** means the means depth from the natural ground surface to the upper surface of the zone of saturation, as measured in an unlined hole or perforated monitoring well during the time of the year when the water table is the highest. The term includes the upper surface of a perched water table.

2.1.1.75 **Septic tank** means a ~~**storage**~~ wastewater settling tank in which settled sludge is in immediate contact with the wastewater flowing through the tank while the organic solids are decomposed by anaerobic action.

2.1.1.76 **Service Connection** means a means a line that provides water or sewer service to a single building or main building with accessory buildings~~, and that is designed to service line specifications~~. The term is synonymous with "connection".

2.1.1.77 **Sewage is synonym**ous with "wastewater" for purposes of this Circular.

2.1.1.78 **Sewer invert** means inside bottom (or flow line) of a sewer pipe.

2.1.1.79 **Shared wastewater system** means a wastewater system that serves or is intended to serve two living units or commercial units. The term does not include a public sewage system as defined in 75-6-102.~~structures.~~ ~~The total number of people served may not exceed 24. In estimating the population served, the reviewing authority shall multiply the number of living units times the county average of persons per living unit based on the most recent census data.~~

~~**Siphon** means a pipe fashioned in an inverted U shape and filled until atmospheric pressure is sufficient to force a liquid from a reservoir in one end of the pipe over a barrier and out the other end. Siphons are sometimes used to gravity-dose an absorption system from a dosing tank or chamber.~~

2.1.1.80 **Slope** means the rate that a ground surface declines in feet per 100 feet. It is expressed as percent of grade.

2.1.1.81 **Soil profile** means a description of the soil strata to a depth of eight feet using the USDA soil classification system method in Appendix B.

2.1.1.82 **Soil consistence** means attributes of soil material as expressed in degree of cohesion and adhesion or in resistance to deformation or rupture. For the purposes of this Circular consistence includes: (1) resistance of soil material to rupture, (2) resistance to penetration, (3) plasticity, toughness, and stickiness of puddled soil material, and (4) the manner in which the soil material behaves when subject to compression. Although several tests are described, only those should be applied which may be useful.

2.1.1.83 **Soil texture** means the amount of sand, silt, or clay, measured separately in a soil mixture

2.1.1.84 **Surge Tank** means a watertight structure or container that is used to buffer flows. ~~**Surge Tank**- a watertight structure or container that is part of a gray water irrigation system.~~

2.1.1.85 **Synthetic drainage fabric** means a nonwoven drainage fabric with a minimum weight per square yard of 4 ounces, a water flow rate of 100 to 200 gallons per minute per square foot, and an apparent opening size equivalent to a No. 50 to No. 110 sieve.

~~**Tertiary treatment** means additional removal of colloidal and suspended solids by chemical coagulation and/or medium filtration for the reduction of nutrients.~~

2.1.1.86 **TSS (Total Suspended Solids)** means solids in wastewater that can be removed by standard filtering procedures in a laboratory and is reported as milligrams per liter (mg/L).

2.1.1.87 **Transport pipe** means the pipe leading from the septic tank or dose tank to the distribution box or manifold.

2.1.1.88 **Uniformity coefficient** (UC) means the sieve size in millimeters (mm) that allows 60 percent of the material to pass (D60), divided by the sieve size in mm allowing 10 percent of the material to pass (D10), as determined by ASTM C117-95 (UC=D60/D10).

2.1.1.89 **Uniform distribution** is a means to distribute effluent into a ~~sand filter, sand mound, or~~ pressure dosed absorption system or sand filter such that the difference in flow (measured in gallons per day per square foot) throughout the ~~absorption~~ treatment system~~, sand filter, or sand mound~~ is less than 10 percent.

2.1.1.90 **Waste segregation** means a system for the Waste segregation systems consist of dry disposal of human toilet waste by a method such as composting, chemical, dehydrating, or incinerator treatment, with a separate disposal method for gray water. ~~**Waste Segregation** – Waste segregation systems consist of dry disposal of toilet waste by a method such as~~

~~composting, chemical, dehydrating, or incinerator treatment, with a separate disposal method for gray water.~~

2.1.1.91 **Wastewater treatment system or wastewater disposal system** means a system that receives wastewater for purposes of treatment, storage, or disposal. The term includes, but is not limited to, pit privies, incinerator and chemical toilets, and experimental systems ~~household, commercial, or industrial wastes; chemicals; human excreta; or animal and vegetable matter in suspension or solution. wastes including, but not limited to: household, commercial, or industrial wastes; chemicals; human excreta; or animal and vegetable matter in suspension or solution.~~

2.1.1.92 **Wet well** means a chamber in a pumping station, including a submersible pump station, where wastewater collects.

2. SITE CONDITIONS

2.1 SITE EVALUATION

2.1.1 General

Information concerning soil and site conditions is needed for the design of subsurface wastewater treatment systems. ~~Those~~ ~~Factors~~ Elements ~~which~~ that must be included in the evaluation ~~evaluated~~ are:

A. soil profile descriptions as described in Section 2.1.4; and
B. soil permeability determined from soil texture or percolation tests if required pursuant to Section 2.1.5; and
C. depth to ground water, bedrock or other limiting layer; and
D. land slope and topographic position; and
E. flooding potential; and
F. amount of suitable area available; and
G. setback distances required in ARM Title 17, Chapter 36, subchapter 3 or 9.

~~thickness of permeable soil above seasonally high ground water, bedrock or other limiting layer, soil properties, land slope, topographic position, flooding hazard and amount of suitable area available, and setback distances required in ARM Title 17, chapter 36, subchapter 3 or 9. For systems with a design wastewater flow greater than 1,000 gallons per day, the potential for ground water mounding must be evaluated~~

2.1.2 A qualified individual shall conduct a site evaluation in the location of each proposed system. Soils scientists, professional engineers, registered sanitarians, and geologists with experience and knowledge of soil morphology will be considered to be qualified. Others may perform site evaluations after providing to the reviewing authority evidence of experience describing soils.

~~Evaluation of soil factors~~

~~Soil properties must be evaluated using a soil profile and must be supported by percolation tests, soils maps, and other available scientific information when variability of the soils indicates additional information is necessary to determine the appropriate application rate.~~

2.1.3 Existing soil information

Soil surveys are usually found at the local USDA Natural Resources Conservation Service (NRCS) office or through the USDA WebSoil Survey website. Soil surveys offer good preliminary information about an area and can be used to identify potential problems; however, they cannot substitute for a field investigation.

2.1.4 Soil profile description

Soils must be described in accordance with Appendix B and USDA Natural Resources and Conservation methods.

Soil ~~pits~~ within 25 feet of the boundaries of the proposed absorption system and its replacement area are required for soil descriptions. Soil pits should be located outside the boundaries of the proposed absorption system so that they do not act as a conduit for effluent between soil horizons. The number and depth of soil pit descriptions for a subsurface wastewater treatment system must comply with the requirements of ARM Title 17, Chapter 36, subchapter 3 or 9 as applicable.

For proposed primary and replacement absorption systems that are not located in the same immediate area, a soil profile may be required for each proposed absorption system area. The minimum depth of soil profile descriptions must be 8 feet unless a limiting layer is encountered at a shallower depth. If a limiting layer is encountered at less than 8 feet in the soil profile or if the site is in an area where bedrock outcroppings exist, one soil profile is required at each end of both the absorption system and the replacement area to ensure adequate depth of soil. The soil profile may need to be completed to a greater depth to demonstrate compliance with other applicable ~~nondegradation~~ rules ~~for phosphorous breakthrough.~~

For lots 2 acre in size or less, the applicant shall physically identify the absorption system location by staking or other acceptable means of identification. For lots greater than 2 acre in size, the reviewing authority may require the applicant to physically identify the absorption system location.

2.1.4.1 The following soil properties must be evaluated in accordance with Appendix B to the full depth of the hole and reported:

A. thickness of layers or horizons; each of these layers or horizons needs to be described; ~~and,~~

B. ~~T~~texture, structure, and ~~consistence~~ consistency of soil horizons; and,

C. ~~C~~color (preferably described by using the notation of the Munsell color scheme) and color variation (redoximorphic features); and

D. ~~D~~depth of water, if observed; and,

E. ~~E~~estimated depth to seasonally high ground water and basis for the estimate; and,

F. ~~D~~depth to ~~and type of~~ bedrock or other limiting layer if observed; and

G. ~~S~~stoniness reported on a volume basis (i.e. the percentage of the soil volume occupied by particles greater than 2 mm in diameter); ~~and~~

H. ~~P~~plasticity; and

I. ~~O~~other prominent features such as roots, etc.

2.1.5 Percolation tests or infiltrometer tests

The reviewing authority may require a percolation test when the soils are variable or other conditions create the need to verify trench sizing.

Percolation tests, if required, must be conducted at the approximate depth of proposed construction. For elevated sand mounds ~~and at-grade systems,~~ the depth of the percolation test hole must be 12 inches. Additional percolation tests may be required to determine the existence of a limiting layer. The percolation tests must be performed in accordance with the procedures contained in Appendix A. ~~When the proposed replacement area is not immediately adjacent to the primary absorption system, at lease one percolation test must be conducted within the boundaries of the replacement area.~~

When more than one percolation test is conducted within the boundaries of a proposed absorption system, the percolation rate will be determined based on the arithmetic mean of the percolation test values.

2.1.6 The size of the site and the amount of suitable area must be evaluated in conjunction with the size of the proposed ~~size of the~~ subsurface wastewater system and locations of other features requiring a minimum separation distance.

2.1.7 Table 2.1-1 and the soil descriptions outlined in Appendix B must be used to determine application rates for subsurface wastewater treatment systems.

TABLE 2.1-1
Soil Texture Descriptions are found in Appendix B

Texture	Percolation Rate (min/in)	Application rate (gpd/ft^2) (a) (b)
Gravel with less than 10% fines, gravelly sand or very coarse sand (c)	<3 min/in	0.8
Loamy sand, coarse sand (d)	3-<6 min/in	0.8
Medium sand, sandy loam	6- <10 min/in	0.6
Fine sandy loam, loam	10- <16 min/in	0.5
Very fine sand, sandy clay loam, silt loam	16-<31 min/in	0.4
Clay loam, silty clay loam,	31-<51 min/in	0.3
Sandy clay	51-<121min/in	0.2
Clays, silts, silty clays (e)	121- <240 min/in	0.15
Clays, silts, silty clays (f)	>240 min/in	Additional Soil Information may be Required

a) If, prior to an allowed absorption area size reduction, more than 500 lineal feet (or 1000 square feet) of distribution line is needed, then uniform pressure distribution designed in accordance with Chapter 4.3 must be provided

b) Comparison of the soil profile report, percolation rate and NRCS soils report should be used to select-the most conservative application rate.

c) Systems installed in gravel or coarser textured soils with less than 10 % fines or with percolation rates faster than 3 min/in must be pressure dosed and sand lined in accordance with Chapters 4.3 and 6.4 respectively.

d) Uniform pressure distribution designed in accordance with Chapter 4.3 must be provided for these soils if there is less than 6 feet from the bottom of the trench to a limiting layer.

e) Percolation tests must be conducted in accordance with Appendix A.

f) Soils with percolation rates greater than 240 minutes per inch must be sized in accordance with application rates determined using ASTM D5093-02. Only ETA or ET systems design in accordance with Chapter 6.7 may be used.

2.1.8 Site factors

The land slope, potential for flooding ~~and surface water concentration~~, and amount of suitable area must be evaluated.

2.1.8.1 Type and percent of land slope

The type (concave, convex, or plane), percent, and direction of land slope must be reported, along with the method of determination. The reviewing authority may require a 2’ contour map of the area for sites having slopes exceeding 15% within 25’ of the absorption system or replacement area.

2.1.8.2 Flooding and surface water

The potential for flooding or accumulation of surface water from storm events must be evaluated. Floodplain maps, when available, must be included as part of the evaluation.

2.1.8.3 Ground water and surface water quality impact

Compliance with the nondegradation requirements of the Montana Water Quality Act (75-5-301, MCA) must be demonstrated.

2.1.8.4 Ground water monitoring

When required, ground water monitoring must be conducted in accordance with Appendix C.

2.1.9 Any person performing a site evaluation on a parcel shall submit to the reviewing authority all data and locations of all test holes and percolation tests performed on the parcel.

2.2 SITE MODIFICATIONS

2.2.1 General

Site modifications, as described in Sections 2.2.2, 2.2.3 and 2.2.4 of this chapter, may ~~only~~ be used only for replacement of failing systems. ~~The following systems may not be used for new systems in subdivisions, although cut systems and fills systems may be used for replacement areas for new subdivisions, provided the~~ Site preparation for cut and fill modifications must be ~~(cut or fill) is~~ completed prior to final approval. Minor leveling, as described in Section 2.2.5 of this chapter, will be allowed for both new systems and replacement systems. All new and replacement subsurface treatment systems must meet the requirements of this Circular.

2.2.2 Artificially drained site

~~General~~
Artificially drained site modifications may be used only for the replacement of failing systems only and may not be used for new systems.

Prior to construction of any site drainage system such as a field drain, under drain, or vertical drain, an evaluation of the site must be performed, including: soil profile descriptions; slope; depth to bedrock or other impervious layer; estimation of depth to seasonally high ground water; topography; distance to wells, seeps, streams, ponds, or other open water; and any other pertinent considerations.

2.2.2.1 Design of drain system

A. The drainage method chosen (curtain drain, vertical drain, or under drain) and the reason for this choice must be detailed. Drawings showing dimensions of the drain system and materials to be utilized must be provided.

B. The drainage system must be constructed according to the specific design approved by the reviewing authority.

2.2.2.2 The type of wastewater treatment system to be approved must depend upon the depth to seasonally high ground water. A minimum of 4 feet of natural soil from the bottom of the ~~trench over the entire area of the proposed absorption system and replacement area~~ infiltrative surface to the seasonally high ground water must ~~have been~~ be achieved by the site drainage system. An adequate horizontal separation distance must be maintained between the drain and the absorption system ~~in order~~ to reduce the potential for effluent to enter the drain.

2.2.2.3 The reviewing authority may require monitoring of the depth to seasonally high ground water after installation of the drainage system.

2.2.3 Cut systems

~~General~~
Cut systems may be used only for the replacement of failing systems and may not be used for new subsurface treatment systems. The reviewing authority must initially approve the cut location with the site modification completed prior to final system approval.

~~Limitation~~

~~Absorption trenches for these systems must meet the same requirements as a standard absorption trench~~.

2.2.3.1 A minimum of 4 feet of natural soil from the bottom of the infiltrative surface to a limiting layer must be maintained

2.2.3.2 Design

A. Cut areas for the replacement absorption system must be physically completed prior to approval. Two soil test holes must be excavated and detailed soil profile descriptions must be provided prior to excavation. Percolation tests may be required after the cut has been completed.

B. A complete lot layout must be submitted showing the cut areas, the uphill and downhill slope, and slope across the cut area. Slope across the absorption system site must be a uniform slope.

C. Cut systems will only be considered on slopes that do not exceed 25 percent and where downhill slope below the cut area is not greater than 25 percent.

2.2.3.3 Report

The designer shall submit a letter of verification indicating that the site meets minimum requirements of applicable rules after the cut has been completed.

2.2.4 Fill system
~~General~~
Fill systems may be used only for replacement of existing failed systems and may not be used for new subsurface treatment systems. The reviewing authority must initially approve the fill location with the site modification completed prior to final system approval. A registered professional engineer or certified soil scientist must design fill systems. As-built drawings and soil compaction results must be submitted by the designer to insure proper compaction of the fill system.

2.2.4.1 Location

A. ~~Any parcel that will undergo land modification by filling must have enough area suitable for absorption system placement.~~ The entire area necessary for the replacement absorption system must be filled prior to final approval of the system.

B. Fill systems may not be installed on soils with a percolation rate slower than 60 minutes per inch. Side slopes on the fill may not exceed 25 percent (4:1).

2.2.4.2 A minimum of 4 feet of natural soil from the bottom of the infiltrative surface of the subsurface absorption system to a limiting layer must be maintained. Fill cannot be used to overcome minimum vertical or horizontal separation distances.

2.2.4.3 Fill material

Soils used for fill may not be finer than sandy loam with a maximum of 20 percent passing the No. 100 sieve.

2.2.4.4 Design

A. System configuration dimensions and orientation must be submitted in a design report and drawings prepared by a registered professional engineer or certified soil scientist. The design report and drawings must be approved by the reviewing authority prior to the placement of fill material. As-built drawings and a letter of certification from the designer must be submitted within 90-days of construction completion.

~~Fill may be used only in areas where there is four feet of separation distance from the natural ground surface to a limiting layer~~. ~~Fill cannot be used to overcome minimum vertical or horizontal separation distances~~.

B. Three percolation tests evenly spaced across the completed fill must be performed at the depth of the proposed infiltrative surface as a basis for design application rate.

C. The absorption system must be sized on the basis of the percolation rate for either the soil beneath the fill material or the percolation rate of the fill material, whichever is slower.

2.2.4.5 Construction

A. All native vegetative cover must be removed ~~for~~ from the area to be filled.

B. Fill material must not be put in place when the fill or the original soil surface is frozen.

C. Fill material must be placed in lifts and compacted as specified in ~~by~~ the design report and drawings prepared by a registered professional engineer or certified soil scientist ~~to obtain~~ so that stable soil structure conditions are achieved.

D. Absorption ~~trenches~~ systems must be set back at least 25 ~~24~~ feet from the lower edge of the filled area on slopes of 6 percent or greater. For slopes less than 6 percent, absorption ~~trenches~~ systems must be set back at least 10 ~~3~~ feet on all sides prior to starting the side slope.

E. The fill area must be seeded with a suitable grass to aid in stabilization.

2.2.5 Minor Leveling

Minor leveling is limited to sites with a natural ground slope of 15% or less. A parcel may undergo minor leveling by cutting and/or filling of the natural ground surface up to and no more than a 12-inch depth.

The bottom 12-inches of the infiltrative surface must be located in native soil and all vertical depth requirements must be met.

A minimum of 4 feet of natural soil from the bottom of the infiltrative surface to a limiting layer must be maintained.

A detailed site plan must be provided of the area proposed for minor leveling showing the contours and other pertinent land features, both before and after minor leveling.

3. WASTEWATER

3.1 WASTEWATER FLOW

3.1.1 General

The purpose of this chapter is to provide a method for estimating wastewater flows. Subsurface wastewater treatment system flow rates are based on type of use, size of the home site including number of bedrooms, or number of people. The requirements for shared, multi-user, or public subsurface treatment systems, as required in ARM 17.36.326, must be met.

3.1.2 Residential wastewater ~~flows~~ design flow rates must be estimated as follows: ~~Design wastewater flow for residential dwelling units must be in accordance with the following table. Single-family dwelling units will be considered to have three bedrooms unless otherwise approved~~

A. When the number of individual living units on a single or common absorption system is 9 or less, the following table must be used. Sizing is based on individual living units, not collective number of bedrooms. Living units will be considered to have three bedrooms unless otherwise ~~approved~~ specified.

1 bedroom	150 gpd
2 bedrooms	225 gpd
3 bedrooms	300 gpd
4 bedrooms	350 gpd
5 bedrooms	400 gpd
Each additional bedroom	add 50 gpd

B. When the number of living units on a single or common absorption system is 10 or more, the design flow rate per living unit may be reduced to 100 gallons per day per person.An average of 2.5 persons per living unit must be used to calculate total design flow unless site specific information is supplied to the reviewing authority.

A detailed set of plans, specifications and an operation and maintenance plan are required. The operation and maintenance plan must meet the requirements in Appendix D.

3.1.3 Nonresidential wastewater flow

Typical daily flows for a variety of commercial, institutional, and recreational establishments are presented in Tables 3.1-1 and 3.1-2. 5~~-1 and 5-2~~ For design purposes, the typical flows must be used as minimum design flows. Greater design flows may be required where larger flows are likely to occur, such as resort areas. Design flow must be computed using the total number of units in the proposed facility times the typical daily flow in the tables, with no reduction allowed for occupancy rates. Where the system includes several different types of uses from the tables, each use must be computed separately, and the design flow must be based on the sum of all of the uses. A means of flow measurement (such as flow meters or pump run-time meters) may be required.

As an alternative to the flows listed in the tables, design flow may be based on actual water use data from similar facilities. If daily flows are used, the design flow must be 1.1 times the highest daily flow. If monthly averages are used, the peak design flow must be a minimum of 1.5 times the average flow of the highest month. The water use data must be representative of the facility proposed and for a time period adequate to evaluate annual use of the system. System components may be added (or enlarged) to address peak flows to allow absorption systems to be sized based on average flow.

Expansions to an existing system with actual water use data are also an acceptable method to determine design flows.

~~5.4 Wastewater strength~~

~~Subsurface wastewater disposal systems must be used only for residential strength wastewater. Wastewater exceeding the limits for residential strength wastewater must be pretreated to residential strength prior to discharging to DEQ-4 systems. Effluent from recreational vehicle holding tanks have BOD_5 levels as high as 15 times that of residential strength wastewater and must be pretreated accordingly. High strength waste must be pretreated with systems specifically designed to reduce high strength wastewater to residential strength wastewater. For design, construction, operation and maintenance of systems that treat high strength wastewater, please refer to the Onsite Wastewater Treatment Systems Manual, EPA/625/R-00/008, February 2002.~~

TABLE 3.1-1 ~~5-1~~
TYPICAL WASTEWATER FLOWS FROM COMMERCIAL, INDUSTRIAL, AND OTHER NONRESIDENTIAL SOURCES

Source	Unit	Wastewater Range	Flow, gpd/unit Typical
Airport	Passenger	2-4	3
Automobile Service Station	Vehicle Served	7-13	10
	Employee	9-15	12
Bar	Customer	5	3
	Employee	10-16	13
Church	Seat		3
(Not including a kitchen, food service facility, daycare, or camp)			
Church	Seat		5
(Including kitchen, but not including a food service facility, day care, or camp)			
Daycare	Child	10-30	25
	Employee	10-20	15
Department Store	Toilet Room	400-600	500
	Employee	8-12	10
Hospital, medical	Bed	125-240	165
	Employee	5-15	10
Hospital, mental	Bed	75-140	100
	Employee	5-15	10
Hotel/Motel	Guest	40-56	48
	Employee	7-13	10
Industrial Building	Employee	10-16	13
(Sanitary waste only)			
Laundry	Machine	450-650	580
(Self-serve)	Wash	45-55	50
Office	Employee	7-16	13
Prison	Inmate	75-150	115
	Employee	5-15	10
Rest home	Resident	50-120	85
Restaurant	Meal	2-4	3
School, day:			
With cafeteria, gym, showers	Student	15-30	25
With cafeteria only	Student	10-20	15
Without cafeteria, gym, showers	Student	5-17	11
School, boarding	Student	50-100	75
Shopping Center	Parking Space	1-2	2
	Employee	7-13	10
Store	Customer	1-4	3
	Employee	8-12	10

TABLE 3.1-2 ~~5-2~~
TYPICAL WASTEWATER FLOWS FROM RECREATIONAL FACILITIES

Source	Unit	Wastewater Range	Flow, gpd/unit Typical
Apartment, resort	Person	50-70	60
Bed and Breakfast	Person	20 - 40	40
Cabin, resort	Person	8-50	40
Cafeteria	Customer	1-3	2
	Employee	8-12	10
Campground (developed)	Person	20-40	30
Cocktail lounge	Seat	12-25	20
Coffee shop	Customer	4-8	6
	Employee	8-12	10
Country club	Member present	60-130	100
	Employee	10-15	13
Day camp (no meals)	Person	10-15	13
Dining hall	Meal served	4-10	7
Dormitory, bunkhouse	Person	20-50	40
Hotel/Motel, resort	Person	40-60	50
Store, resort	Customer	1-4	3
	Employee	8-12	10
Swimming pool	Customer	5-12	10
	Employee	8-12	10
Theater	Seat	2-4	3
Visitor center	Visitor	4-8	5
~~Travel trailer parks~~ Recreational Vehicles without individual hookups for water or sewer	Space		50
~~Travel trailer~~ Recreational Vehicles ~~without parks~~ with individual hookups for water and/or sewer	Space		100

3.2 HIGH STRENGTH WASTEWATER

3.2.1 General

Nonresidential establishments may have the potential to produce wastewater considered high-strength. Elevated levels of BOD_5, TSS, and FOG will reduce the effectiveness of on-site wastewater treatment systems by increasing the biological demand on downstream components in the system, by containing inorganic compounds that are not easily broken down, and by accelerating mechanical clogging of the infiltrative surface. These establishments often produce effluent with variations of flow rate including intermittent flow, seasonal flow or sporadically high flow rates.

Unless information is supplied to the reviewing authority demonstrating that the wastewater meets residential strength standards, all nonresidential establishments must comply with the requirements of chapter 3.2.

Nonresidential establishments are listed in Table 3.1-1, 3.1-2 and may also include, but are not limited to:

Athletic Facilities
Bakeries
Beauty Shops/Nail Salon
Breweries
Car washes
Food processing facilities
Funeral homes and Crematoriums
Facilities with separate gray water plumbing
Hobby woodworking shops or art studios
Manufacturing facilities
Nursing homes
Rest Areas
RV dump stations
Tanneries
Veterinarian clinics

Nonresidential structures or establishments that produce or contain any industrial or chemical components may be required to obtain a Montana Ground Water Pollution Control System permit regardless of system size.

The United States Environmental Protection Agency has classified subsurface wastewater absorption systems associated with many nonresidential sources as injection wells and should be contacted regarding any federal rules that may apply.

3.2.2 High strength wastewater must be treated to the following standard prior to final disposal in the subsurface absorption system:

BOD_5 < 300 mg/L; and
TSS < 150 mg/L; and
Fats, oils, and grease < 25 mg/L

3.2.3 Wastewater with high fats, oils and greases

Wastewater leaving restaurants, nonresidential kitchens or other institutions that have high levels of Fats, Oils, or Greases (FOGs) greater than 25 mg/L must have a grease tank or other treatment system approved by the reviewing authority. This treatment must occur prior to wastewater entering the septic tank.

3.2.3.1 Grease tanks

A. Grease tanks must be sized based upon the daily design flow estimates in Chapter 3, with the minimum acceptable tank size being 1,000 gallons. Grease tanks must provide a minimum of 24-hours of holding time to allow FOGs to cool and come out of emulsion. Establishments that experience surge loading must provide larger grease tanks designed for longer holding periods.

B. Grease tanks must be constructed in accordance with Section 5.1.6.

C. Grease tanks must have inlet and outlet baffles. The baffles must extend down from the top of the tank with the openings near the bottom. The chamber between the baffles must be sized to contain the expected FOG volume between pumping periods.

D. Wastewater from all food preparation and clean-up areas must be plumbed separately into the grease tank. Cross connections with blackwater sewers is not allowed.

E. Effluent from the grease tank must be plumbed into the septic tank.

3.2.3.2 Other treatment systems designed to treat FOGs will be reviewed on a case by case basis.

3.2.4 A design report must be submitted along with plans and specifications that meet the following criteria:

3.2.4.1 A statement describing the type of business or industry and the end products and byproducts that will be disposed of in the wastewater system.

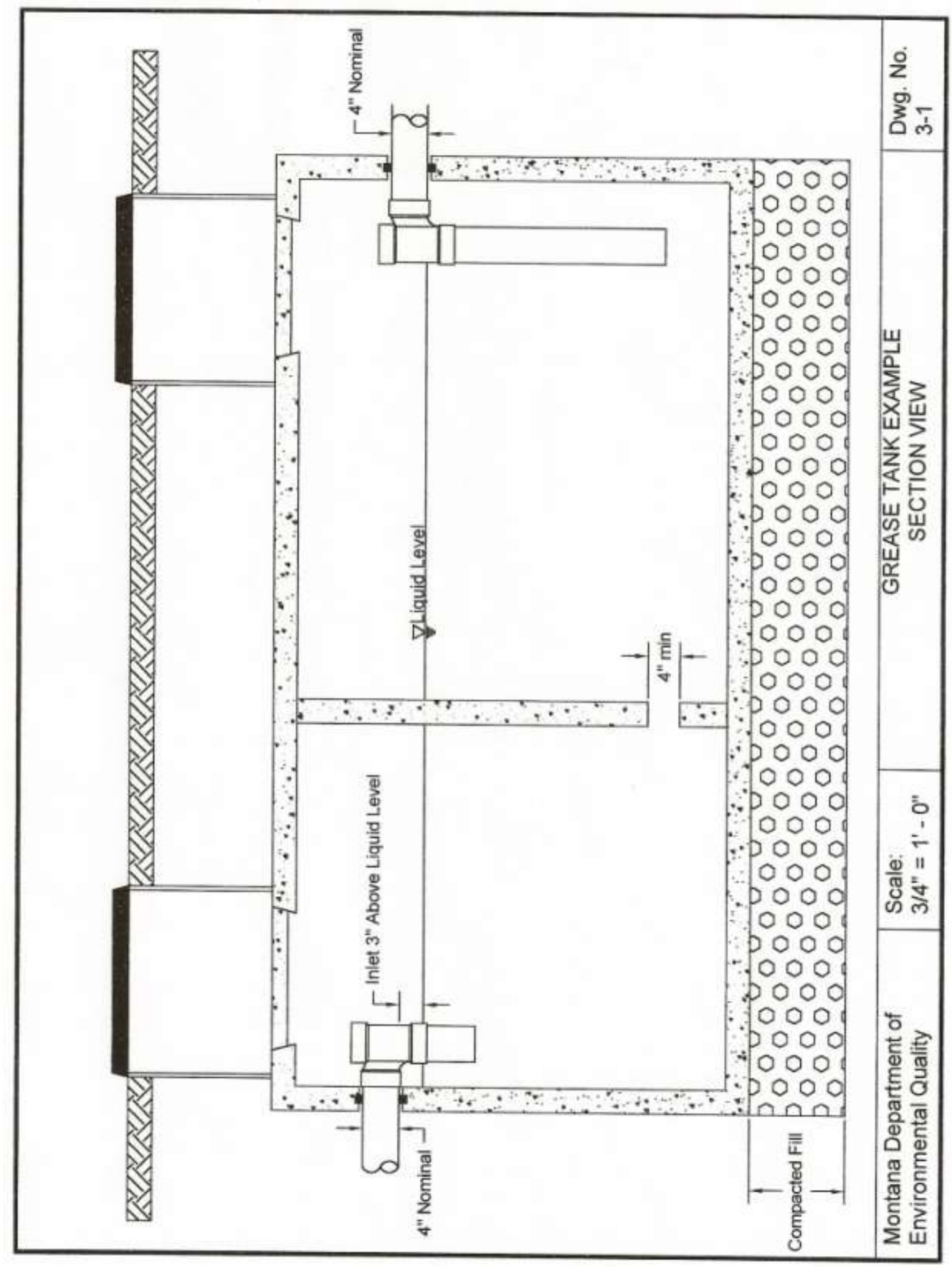
3.2.4.2 Description, plans and specifications that detail the treatment of the high strength wastewater.

3.2.5 Uniform pressure distribution designed in accordance with Chapter 4.3 must be provided for all absorption systems that accept treated high strength waste.

3.2.6 All high strength waste treatment systems must submit an operation and maintenance plan in accordance with Appendix D and this chapter.

3.2.6.1 The operation and maintenance plan must include procedures for each component of the wastewater treatment system, Material Safety Data Sheets (MSDS) for chemicals used, as well as a perpetual contract for operation and maintenance of the system must be included.

3.2.6.2 Sampling records must be kept on site and made available to the reviewing authority upon request.


4" Nominal
Inlet 3" Above Liquid Level
Liquid Level
4" min
4" Nominal
Compacted Fill
Montana Department of
Environmental Quality
Scale:
3/4" = 1' - 0"
GREASE TANK EXAMPLE
SECTION VIEW
Dwg. No.
3-1

3.3 WATER TREATMENT WASTE RESIDUALS

3.3.1 General

Wastewater from ion exchange water treatment systems, water softening treatment systems, demineralization water treatment systems, or other water treatment systems that produce a discharge may be disposed using an onsite wastewater treatment absorption system. A Montana Ground Water Pollution Control System permit and nondegradation analysis may be required.

3.3.2 The wastewater (backwash) from water softeners may be discharged to a wastewater treatment system only if the installed water softener:

A. regenerates using a demand-initiated regeneration control device; and

B. is connected only to interior plumbing for potable water usage and not to exterior irrigation water lines.

3.3.3 Wastewater from water treatment devices, including water softeners, iron filters and reverse osmosis units, may not be discharged into an experimental, (or proprietary on-site wastewater treatment systems unless the quality and quantity of discharge meets the recommended usage, operation and maintenance specifications of the designer or manufacturer of the system. If such specifications are not available, then approval for the discharge must be obtained from the reviewing authority.

3.3.4 Wastewater from water treatment devices, including water softeners, iron filters and reverse osmosis units, may be discharged to a dry well, a separate drainfield with pipe, gravelless or other approved absorption chambers or onto the ground if not prohibited by other regulations.

3.3.3 An operation and maintenance plan for all components of the water treatment and wastewater treatment systems must be submitted in accordance with Appendix D.

3.3.4 The reviewing authority may require that wastewater treatment residuals be disposed in a separate subsurface wastewater treatment system unconnected to the system for the disposal of sanitary wastewater.

4. COLLECTION, PUMPING AND EFFLUENT DISTRIBUTION SYSTEMS

4.1 COLLECTION SYSTEMS

4.1.1 General

4.1.1.1 Sewer collection systems as described in this chapter are the system of pipes, and other appurtenances that receive and convey wastewater or effluent either by gravity or pressure to a treatment system. This chapter discusses sewer services, mains (gravity and force), alternative collection systems, and necessary setbacks.

4.1.1.2 A sewer service means a line that provides water or sewer service to a single building or main building with accessory buildings. The term is synonymous with "service connection

4.1.1.3 A sewer main means any line providing water or sewer to multiple service connections, any line serving a water hydrant that is designed for firefighting purposes, or any line that is designed to water or sewer main specifications.

4.1.1.4 Sewer collection systems must be designed for wastewater only. Rain water from roofs, streets, and other areas; cooling water; surface water drainage; groundwater from foundation drains; etc., are not permitted in wastewater sewers.

4.1.1.5 In general, flow used for designing sewers must consider ultimate population to be served, maximum hourly wastewater flow, and possible infiltration.

4.1.1.6 Sewer extensions should be designed for projected flows even when the diameter of the receiving sewer is less than the diameter of the proposed extension. A schedule for future downstream sewer relief may be required by the Department.

4.1.2 Sewer Services

4.1.2.1 Sewer services must be made of PVC that meets the requirements of ASTM D 3034, Schedule 40, or Schedule 80; and meets ASTM D 1785; Joints must be an integral bell-and-spigot joint with rubber elastomeric gasket or solvent cement joints. When using ASTM D 3034, rock-free bedding is required. Schedule 40 pipe must be used leading into and out of the septic tank, and in the area of backfill around the tank for a minimum length of at least 10 feet.

4.1.2.2 Transition connections to other materials must be made by adapter fittings or one-piece molded rubber couplings with appropriate bushings for the respective materials. All fittings must be at least of equivalent durability and strength of the pipe itself.

4.1.2.3 A sewer service from the structure to the septic tank must be at least 4 inches in diameter and must be placed at a minimum slope of 1/4 inch per foot toward the point of discharge unless pressurized.

4.1.2.4 Sewer services must be installed at uniform slope.

4.1.2.5 Sewer services must be designed to prevent freezing.

4.1.2.6 Cleanouts are recommended within 3 feet of the building, at angles greater than 45 degrees, and for continuous pipe runs greater than 150 feet in length.

4.1.2.7 Sewer services and plumbing must conform to applicable local and state plumbing codes, or to the Uniform Plumbing Code, as amended by the Administrative Rules of Montana, or other applicable codes.

The Department discourages the use of shared service lines.

4.1.2.8 Service connections to the sewer main must be watertight and may not protrude into the sewer. If a saddle type connection is used, it must be a device intended to join with the types of pipe that are to be connected. All materials used to make service connections must be compatible with each other and with the pipe materials to be joined. All materials must be corrosion-proof.

4.1.3 Gravity Sewer Mains

4.1.3.1 A gravity sewer main conveying raw wastewater must be at least 8 inches (203 mm) in diameter, except gravity sewer mains within private property. Trailer courts, condominiums, apartments, etc. are allowed mains no smaller than 6 inches in diameter, provided that the 6 inch diameter main can be shown to be hydraulically feasible, that no future expansion is anticipated, and that maintenance will not be increased due to the smaller diameter.

4.1.3.2 In general, sewers should be sufficiently deep to receive wastewater from basements and to prevent freezing. The minimum depth of bury must not be less than 4 feet (to the top of pipe) without justification by the design engineer. The prevailing local building code must be used in determining the maximum frost depth; however, the designer must consider increasing that depth if the site is located where local information suggests greater frost penetration. Insulation must be provided for sewers that cannot be placed at a depth sufficient to prevent freezing. Insulation used for this purpose must be specifically designed to withstand compaction and for use in subsurface locations. It must retain the insulating value for the design life of the sewer.

4.1.3.3 Buoyancy of sewers and manholes must be considered and flotation of the component must be prevented with appropriate construction where high groundwater conditions are anticipated.

4.1.3.4 Slopes

A. All sewers must be designed and constructed to provide the pipe-full velocities of not less than 2.0 feet per second (0.6 m/s) using Manning's formula with an "n" value of 0.013 and the minimum slopes listed in the following table. These values are based on Manning's formula using an "n" value of 0.013.The following are the minimum slopes that must be provided for sewer mains; however, slopes greater than these are desirable.

Minimum Slope in Feet for Sewer Main

Sewer Main Size	Per 100 Feet (m/100m)
6 inch (152 mm)	0.60
8 inch (203 mm)	0.40
10 inch (254 mm)	0.28
12 inch (305 mm)	0.22
14 inch (356 mm)	0.17
15 inch (381 mm)	0.15
16 inch (406 mm)	0.14
18 inch (457 mm)	0.12
21 inch (533 mm)	0.10
24 inch (610 mm)	0.08
27 inch (686 mm)	0.067
30 inch (762 mm)	0.058
33 inch (838 mm)	0.052
36 inch (914 mm)	0.046
39 inch (991 mm)	0.041
42 inch (1067 mm)	0.037

Sewers 48 inches (1200 mm) or larger should be designed and constructed to give mean velocities, when flowing full, of not less than 3.0 feet per second (0.9 m/s), based on Manning's Formula using an "n" value of 0.013.

B. Pipe slopes slightly less than those required may be permitted, only under extenuating circumstances through an approved deviation. Such decreased slopes will only be considered where the depth of flow will be 0.3 of the diameter or greater for design average flow. The operating authority of the sewer system will give written assurance to the reviewing agency that any additional sewer maintenance required by reduced slopes can be provided.

C. The pipe diameter and slope must be selected to obtain the greatest practical velocities to minimize settling problems. Oversize sewers will not be approved to justify using flatter slopes. If the proposed slope is less than the minimum slope of the smallest pipe which can accommodate the design peak hourly flow, the actual depths and velocities at minimum, average, and design maximum day and peak hourly flow for each design section of the sewer must be calculated by the design engineer and included with the plans.

D. Sewers must be laid with uniform slope between manholes.

E. Sewers on 20 percent slopes or greater must be anchored securely with concrete, or equal, with anchors spaced as follows (as a minimum):

a. Not over 36 feet (11 m) center to center on grades 20 percent and up to 35 percent;

b. Not over 24 feet (7.3 m) center to center on grades 35 percent and up to 50 percent; and

c. Not over 16 feet (4.9 m) center to center on grades 50 percent and over.

4.1.3.5 Where velocities greater than 15 feet per second (4.6 m/s) are attained, special provision must be made to protect against displacement by erosion and impact.

4.1.3.6 Alignment

A. Sewer mains 24 inches (610 mm) or less in diameter must be laid with straight alignment between manholes. Straight alignment must be checked by either using a laser beam or lamping.

B. Curvilinear alignment of sewers larger than 24 inches (610 mm) may be considered on a case-by-case basis if compression joints are specified and ASTM or specific pipe manufacturers' maximum allowable pipe joint deflection limits are not exceeded. Curvilinear sewers must be limited to simple curves that start and end at manholes. When curvilinear sewers are proposed, the required minimum slopes indicated in 33.41 (Recommended Minimum Slopes) must be increased accordingly to provide a minimum velocity of 2.0 feet per second (0.6 m/s) when flowing full.

C.

4.1.3.7 Materials

A. Any generally accepted material for sewers will be given consideration, but the material selected should be adapted to local conditions, such as: character of industrial wastes, possibility of septicity, soil characteristics, exceptionally heavy external loadings, abrasion, corrosion, and similar problems.

B. Suitable couplings complying with ASTM specifications must be used for joining dissimilar materials.

C. All sewers must be designed to prevent damage from superimposed live, dead, and frost-induced loads. Proper allowance must be made for loads on the sewer because of soil and potential groundwater conditions, as well as the width and depth of the trench. Where necessary, special bedding, haunching and initial backfill, concrete cradle, or other special construction must be used to withstand anticipated potential superimposed loading or loss of trench wall stability. See ASTM D 2321 with respect to PVC pipe installation, when appropriate.

D. For new pipe materials for which ASTM standards have not been established, the design engineer shall provide complete pipe specifications and installation specifications developed on the basis of criteria adequately documented and certified in writing by the pipe manufacturer to be satisfactory for the specific detailed plans.

4.1.3.8 Installation

1. Installation specifications must contain appropriate requirements based on the criteria, standards, and requirements established by industry in technical publications. Requirements must be set forth in the project specifications for the pipe and methods of bedding and backfilling the pipe.

2. The width of the trench must be ample to allow the pipe to be laid and jointed properly and to allow the bedding and haunching to be placed and compacted to adequately support the pipe. The trench sides must be kept as nearly vertical as possible. When wider trenches are specified, appropriate bedding class and pipe strength must be used.

3. All trenches must be constructed according to current Montana Department of Labor and Industry or O.S.H.A. standards, as appropriate. In unsupported, unstable soil, the size and stiffness of the pipe, stiffness of the embedment and insitu soil and depth of cover must be considered in determining the minimum trench width necessary to adequately support the pipe.

4. Ledge rock, boulders and large stones must be removed to provide a minimum clearance of 4 inches (102 mm) below and on each side of all pipe(s).

5. Pipe Bedding Materials and Placement

i. Type 1 Pipe Bedding includes the material placed from 4 inches (100mm) below the bottom of the pipe, around the pipe, and up to the springline of the pipe.

Type 1 Bedding consisting of sand, sandy gravel, or gravel having a maximum 3/4 inch size (19mm) and a maximum plasticity index of 6, determined by AASHTO T89 and T90 or by ASTM D4318.

Where trench excavation encounters wet or unstable material, Type 1 Pipe Bedding must be free draining and non-plastic.

Refer to Standard Drawing 02221-1 and Special Provisions for other requirements.

Select Type 1 Bedding includes the material placed from the springline of the pipe to 6 inches (15cm) over the pipe.

Select Type I Bedding shall consist of soil, sand or fine gravel, free from clods, lumps of frozen material, or rock exceeding 1-1/2 inches (38mm) in its greatest dimension.

Excavated trench material may be screened or sorted for use as backfill subject to approval of the Engineer.

Where trench excavation encounters wet or unstable material, Select Type 1 Bedding must be free draining and non-plastic.

ii. Type 2 Pipe Bedding is used as directed by the Engineer to replace unsuitable material encountered in the trench bottom.

Place Type 2 Pipe Bedding from the bottom of the Type 1 Bedding material to the depth required to adequately support the pipe.

Type 2 Bedding shall consist of granular material meeting the following gradation:

Sieve Opening	% Passing
3 Inch -	100
No. 4 0 -	25
No. 8 0 –	10

iii. Place in maximum 6" lifts and compacted to 95% of Maximum Dry Density as determined using AASHTO T-99 or ASTM D698.

iv. Embedment materials for bedding, haunching and initial backfill Classes I, II or III, as described in ASTM D 2321, must be used. Backfill, must be carefully compacted for all flexible pipe. The proper strength pipe, must be used with the specified bedding to support the anticipated load based on the type of soil encountered, and potential groundwater conditions.

v. All water entering the excavations or other parts of the work must be removed until all the work has been completed. No sanitary sewer may be used for the disposal of trench water, The Department must be contacted immediately if either contaminated soil or contaminated groundwater is encountered. If contamination is anticipated, an acceptable plan for handling and disposal must be submitted to the Department for approval.

vi. Final backfill must be of a suitable material removed from the excavation except where other material is specified. Debris, frozen material, clods or stones larger than 8 inches, organic matter, or other unstable materials may not be used for final backfill within 1 foot of the top of the pipe. Final backfill must be placed in such a manner as not to disturb the alignment of the pipe.

Type A trench backfill used in streets and paved areas shall be placed in 8 inch lifts within 3 percent of optimum moisture content and compacted to at least 95 percent of maximum dry density determined by AASHTO T99 or by ASTM D698 or as recommended by a geotechnical engineer.

Type B trench backfill used for unpaved alleys, cultivated areas, borrow pits, unimproved streets, or other unsurfaced areas shall be shall be placed in 8 inch lifts within 3 percent of optimum moisture content and compacted to at least 90 percent of maximum dry density determined by AASHTO T99 or by ASTM D698 or as recommended by a geotechnical engineer.

Type C trench backfill used in open and unimproved areas outside of the public right-of-way shall be shall be placed in 12 inch lifts at densities equal to or greater than the densities of adjoining undisturbed soils.

4.1.3.9 Testing Requirements

A. The design engineer has the option of requiring deflection testing of all or a portion of flexible pipe installations to assure the quality of construction. Flexible pipe is a conduit that will deflect at least 2 percent without any sign of structural distress. Deflection tests, when performed on PVC pipe, must be conducted in accordance with ASTM D3034 and must satisfy either of the following deflection limitations:

Minimum Period Between Trench Backfilling & Testing	Minimum Mandrel Diameter as a Percent of Inside Pipe Diameter
7 days	95.0
30 days	92.5

B. If deflection exceeds the specified limits, replacement or correction must be accomplished in accordance with requirements in the approved specifications.

C. The rigid ball or mandrel used for the deflection test must have a diameter of at least 95 percent or 92.5 percent (depending on the time of test) of the base inside diameter or average inside diameter of the pipe depending on which is specified in the ASTM Specification, including the appendix, to which the pipe is manufactured. The pipe must be measured in compliance with ASTM D 2122 Standard Test Method of Determining Dimensions of Thermoplastic Pipe and Fittings. Mandrels must have at least nine arms. The test must be performed without mechanical pulling devices.

D. Deflection testing requirements for flexible pipe other than PVC must be determined by the design engineer.

E. The installation of joints and the materials used must be included in the specifications. Sewer joints must be designed to minimize infiltration and to prevent the entrance of roots throughout the life of the system.

F. Leakage tests must be specified. This may include appropriate water or low pressure air testing. The testing methods selected should take into consideration the range in groundwater elevations during the test and anticipated during the design life of the sewer. Sewers with active service connections may be leak tested via video inspection.

G. The leakage exfiltration or infiltration may not exceed 200 gallons per inch of pipe diameter per mile per day (0.019 m3/mm of pipe dia/km/day) for any section of the system. An exfiltration or infiltration test must be performed with a minimum positive head of 2 feet (610 mm).

H. The air test must, at a minimum, conform to the test procedure described in ASTM C-828-86 for clay pipe, ASTM C 924 for concrete pipe, UNI-B-6-90 low pressure test for PVC pipe. For other materials, test procedures must be approved by DEQ.

I. Service connections to the sewer main must be water tight and may not protrude into the sewer. If a saddle type connection is used, it must be a pre-manufactured device intended that is designed to join with the types of pipe that are to be connected. All materials used to make service connections must be compatible with each other and with the pipe materials to be joined. All materials must be corrosion proof resistant.

J. Where casing pipe is used to carry sewers at horizontal borings, stream crossings, water line crossings and other locations, the pipe must conform to the slope requirements of Section 33.4 (Slope), if necessary, and must be rated for the structural and environmental conditions to which it will be exposed. The engineer must provide supporting manufacture’s documentation and calculations as necessary to justify the type and size of casing pipe proposed.

4.1.3.10 Manholes

A. Location

Manholes must be installed: at the end of each sewer line; at all changes in grade, size, or alignment; at all intersections; and at distances not greater than 400 feet (122 m) for sewers 15 inches (381 mm) or less in diameter; and 500 feet (152 m) for sewers 18 inches (457 mm) to 30 inches (762 mm). Greater spacing may be permitted in larger sewers at the discretion of the reviewing authority.

Distances up to 600 feet (183 m) may be approved where cleaning equipment for the stated spacing is provided. Documentation must be provided that such cleaning equipment is readily available and has the cleaning capability stated. Cleanouts may be used only for special conditions and may not be substituted for manholes or installed at the end of laterals greater than 150 feet (46 m) in length.

Cleanouts may not be used in place of manholes on mains of public wastewater systems conveying raw wastewater but may be used in place of manholes on lines conveying septic tank effluent. For systems conveying septic tank effluent, manholes or cleanouts must be located at major junctions of three or more pipes and should be limited to strategic locations for cleaning purposes.

B. Drop Manholes

A drop pipe should be provided for a sewer entering a manhole at an elevation of 24 inches (610 mm) or more above the manhole invert. Where the difference in elevation between the incoming sewer and the manhole invert is less than 24 inches (610 mm), the invert should be filleted to prevent solids deposition.

Drop manholes should be constructed with an outside drop connection. Inside drop connections (when necessary) must be secured to the interior wall of the manhole and provide access for cleaning.

Due to the unequal earth pressures that would result from the backfilling operation in the vicinity of the manhole, the entire outside drop connection must be encased in concrete.

C. Flow Channel

When a smaller sewer joins a large one at a manhole, the invert of the larger sewer should be lowered sufficiently to maintain the same energy gradient. An approximate method for securing these results is to place the 0.8 depth point of both sewers at the same elevation. Special consideration should be given to minimizing turbulence when designing a flow channel within a manhole where there is a change in pipe size.

The flow channel straight through a manhole should be made to conform as closely as possible in shape and slope to that of the connecting sewers. For pipes greater than 8 inches in diameter, the channel walls should be formed or shaped to the full height of the crown of the outlet sewer in such a manner to not obstruct maintenance, inspection or flow in the sewers. For pipes 8 inches or less in diameter, the channel must be formed at least to the spring line of the pipe. When curved flow channels are specified in manholes, including branch inlets, or when entrance or exit losses are significant, minimum required slopes must be increased to maintain acceptable velocities.

A bench must be provided on each side of any manhole channel when the pipe diameter(s) are less than the manhole diameter. The bench should be sloped no less than 1/2 inch (13 mm) per foot (305 mm) (4 percent). A lateral sewer, service connection, or drop manhole pipe may not discharge onto the surface of the bench.

D. Manhole Construction

The minimum inside diameter for manholes is 48 inches (1.22 m); larger diameters are preferable for large diameter sewers. A minimum access diameter of 22 inches (559 mm) must be provided.

Manholes must be of the pre-cast concrete or poured-in-place concrete type. Manholes must be waterproofed on the exterior. Pre-cast concrete manhole sections manufactured in accordance with ASTM C 478M-93 (with Section 16 rejection requirements made mandatory) are exempt from the exterior waterproofing requirement. Manhole lift holes and grade adjustment rings must be sealed with non-shrinking mortar or other material approved by the Department.

Inlet and outlet pipes must be joined to the manhole with a gasketed flexible watertight connection or any watertight connection arrangement that allows differential settlement of the pipe and manhole wall to take place.

Watertight manhole covers are to be used wherever the manhole tops may be flooded by street runoff or high water. Locked manhole covers may be desirable in isolated easement locations or where vandalism may be a problem.

The specifications must include a requirement for inspection and testing for watertightness or damage prior to placing into service.

Vacuum testing, if specified for concrete sewer manholes, must conform to the test procedures described in ASTM C 1244.

Water testing will only be allowed where groundwater is below the bottom of the manhole during testing. Hydrostatic testing shall be conducted by sealing all pipe penetrations to the manhole and filling the manhole to the top of the manhole cone with water. Water may be added over a 24 hour period to compensate for losses due to evaporation and absorption. Following the 24 hour saturation period any loss of water within a 30 minute period shall be a failed test and the manhole must be rejected.

Where corrosive conditions due to septicity or other causes are anticipated, consideration must be given to providing corrosion protection on the interior of the manholes.

Electrical equipment installed or used in manholes where hazardous concentrations of flammable gases or vapors may be present must be suitable for use under corrosive conditions and must comply with the National Electrical Code requirements for Class 1, Group D, Division 1 locations. In addition, equipment located in the wet well must be suitable for use under corrosive conditions. Each flexible cable must be provided with watertight seal and separate strain relief. A fused disconnect switch located above ground must be provided for the main power feed. When such equipment will be exposed to weather, it must meet the requirements for waterproof equipment in NEMA 3R or 4. A 110 volt power receptacle to facilitate maintenance must be provided inside the control panel for lift stations that have control panels outdoors. Ground fault interruption protection must be provided for all outdoor outlets.

4.1.4 Force Mains (Pressurized Sewers)

4.1.4.1 At design pumping rates, a cleaning velocity of at least 2 feet per second (0.61 m/s) must be maintained. It is desirable to have cleaning velocities of at least 3 feet per second. The maximum velocity shall not exceed 8 feet per second for the design pump rate.

Force mains in small grinder and effluent pump installations must be based on a minimum design flow velocity of 2 feet per second and a minimum pipe diameter of 1.5 inches.

4.1.4.2 The minimum force main diameter for raw wastewater is 4 inches (102 mm), except that for design flows of less than 5,000 gpd, the minimum force main diameter is 2 inches (51 mm), if the pump is capable of passing a 2-inch sphere or grinder pumps are provided

4.1.4.3 Materials

A. PVC or High Density Polyethylene (HDPE) sewer pipe will be allowed.

B. PVC sewer pipe must meet the requirements of ASTM D 3034, Schedule 40, or Schedule 80 and meet ASTM D 1785 and must be joined by an integral bell-and-spigot joint with rubber elastomeric gasket or solvent cement joints. When using ASTM D 3034, rock-free bedding is required.

C. HDPE sewer pipe must meet the requirements of ASTM D3350, must meet the minimum cell classification of 435400C as defined and described in ASTM D3350, and must be joined by an integral bell-and-spigot joint with rubber elastomeric gasket or butt fusion weld.

4.1.4.4 Pipe and joints must be equal to water main strength materials suitable for design conditions. The force main, reaction blocking, and station piping must be designed to withstand water hammer pressures and associated cyclic reversal of stresses that are expected with the cycling of wastewater lift stations. Surge protection chambers should be evaluated.

4.1.4.5 Transition connections to other materials must be made by adapter fittings or one-piece molded rubber couplings with appropriate bushings for the respective materials. All fittings must be at least of equivalent durability and strength of the pipe itself.

4.1.4.6 An air relief valve must be placed at high points in the force main to prevent air locking. Vacuum relief valves may be necessary to relieve negative pressures on force mains.

4.1.4.7 Force mains should enter the gravity sewer system at a point not more than 1 foot (0.3 m) above the flow line of the receiving manhole. Corrosion protection for the receiving manhole must be provided.

4.1.4.8 Force mains must be constructed to prevent freezing and must be buried a minimum of 6 feet. Depths greater than 6 feet may be required where local conditions dictate. If it is impossible to achieve sufficient burial depth, insulation may be used to help prevent freezing. However, when proper depth cannot be obtained, the engineer shall submit justification for the lesser depth and heat flow calculations showing that the pipe will not freeze.

4.1.4.9 Friction losses through force mains must be based on the Hazen and Williams formula or other acceptable methods. When the Hazen and Williams formula is used, the value for "C" must be 100 for unlined iron or steel pipe for design. For other smooth pipe materials such as PVC, polyethylene, lined ductile iron, etc., a higher "C" value not to exceed 120 may be allowed for design.

Both new and old pipe conditions must be evaluated, along with the various combinations of operating pumps and minimum and maximum flows, to determine the highest head and lowest head pumping conditions. The effects of higher discharge rates on selected pumps and downstream facilities must be considered.

.

4.1.4.10 Where force mains are constructed of material that might cause the force main to be confused with potable water mains, the force main must be appropriately identified.

4.1.4.11 Leakage tests must be specified, including testing methods and leakage limits.

4.1.4.12 Isolation valves must be used where force mains connect into a common force main. Cleanouts at low points and chambers for pig launching and catching should be considered for any force main to facilitate maintenance.

4.1.5 Alternative Collection Systems

4.1.5.1 Alternative wastewater collection systems include pressurized sewers carrying raw wastewater from grinder pumps, pressurized or gravity sewers carrying effluent, and combinations thereof.

Grinder pump (GP) systems use a macerating type pump to grind the waste into a slurry, which is then pumped to a centralized sewer system for treatment. The slurry enables smaller diameter pipelines to be utilized for the conveyance of sewage. Grinder pumps are commonly used in conjunction with conventional gravity collection systems where a particular service is located below the invert of a gravity collection pipe or there is insufficient vertical drop between the structure and the gravity pipe. Due to increased settling times associated with raw wastewater that has passed through grinder pump stations, septic tank sizing may need to be increased.

Septic tank effluent pump (STEP) systems utilize septic tanks and small diameter force mains for the conveyance of wastewater. Septic tank effluent flows to a pump vault where it is pumped to a centralized collection system. The removal of solids in the septic tank at each service connection enables smaller diameter force mains to be used. Solids must be removed from the septic tanks periodically. Since the liquid conveyed in a STEP system is generally septic, odor and corrosion issues for the downstream collection system may be a concern.
Pumping stations used for STEP systems must meet the requirements of Chapter 4.3.

Small diameter gravity (SDG) systems utilize septic tanks and small diameter sewer mains for the conveyance of wastewater to a centralized location for treatment. The removal of solids in the septic tank at each service connection enables smaller diameter pipelines to be used. Solids must be removed from the septic tanks periodically. Since the liquid conveyed in an SDG system is generally septic, odor and corrosion issues for the downstream collection system may be a concern.

Where SDG and STEP systems comprise a single collection system, the STEP units must not create a backpressure in the SDG lines that negatively impacts flow in the gravity main under all flow conditions.

Standards of Chapters 4.3 Effluent Distribution Systems, and Chapter 5 Septic Tanks of this Circular also apply to alternative sewer systems. This chapter provides standards that are specific only to alternative sewer systems and which override any conflicting standards in the above-referenced chapters.

4.1.5.2 Materials and Design Considerations

A. All piping, valves, pumps and other alternative sewer system components must be ASTM or ANSI/AWWA rated for wastewater applications. For small diameter components (less than 4"), the specified material must have a pressure rating of 200 psi. All system components must be constructed of material that is not readily subject to corrosion by raw or septic wastewater and able to withstand the pressures created during pressure cleaning.

~~B.~~ Detection wires for locating buried pipe are recommended.

C. Cleanouts, air release structures or valve access vaults located in traffic areas must be designed to withstand normal traffic loads without damage.

D. Service lines, mainlines, force mains, and all other system components must be designed and constructed to prevent freezing. The minimum depth of bury must not be less than 6 feet to the top of pipe for pressurized pipes. The minimum depth of bury must not be less than 4 feet to the top of SDG pipe without justification by the design engineer.

4.1.5.3 Manholes and Cleanouts

A. The limited use of manholes is encouraged. Cleanouts can be used in place of manholes at changes in grade, alignment, and at the end of each line to minimize infiltration, reduce odor potential, limit introduction of extraneous materials and reduce cost. Manholes must be located at major junctions of three or more pipes and limited to strategic locations for cleaning purposes. Watertight manhole covers are required for odor control and to limit inflow.

B. Manholes must be waterproofed tested for watertightness and should be of the type, which has the base riser section cast with an integral floor. Manholes must meet the requirements of Section 34.6 (Watertightness) and Section 34.7 (Inspection and Testing).

C. Spacing of cleanouts and manholes depends upon cleaning capabilities. A maximum of 600 feet for mechanically cleaned and jet-cleaned systems and a maximum of 1000 feet for systems cleaned by pigging.

4.1.5.4 Pump Station Desgin Standards for Alternative Collection Stations

In addition to the requirements of this circular the following standards apply to pump stations that pump septic tank effluent.

A. Pumps must be sized to pass the expected wastewater and for the proposed force main diameter. Screens should be considered to protect the pump(s) from clogging

B. Inlet pipes must be extended below the low water elevation in the wet well in order to reduce turbulence and odors.

C. The lift station wet well must have watertight covers for odor control and to limit inflow.

D. A vent must be provided with odor control. The vent can be connected to activated carbon, soil filters, or other odor control devices.

E. The force main sizing must be based upon hydraulic requirements using a minimum design velocity of 1.0 ft/sec based on a Hazen-Williams friction coefficient of 130 to 140. The minimum pipe diameter for force mains is 1.5 inches.

F. Leakage tests must be specified including testing methods and leakage limits.

4.1.5.5 Design Flow/Hydraulic Considerations

A. Peak design flow must be based upon water use records when available. When water use records are not available the peak flow used in the pipeline design must be based on the following equastion:

Q = 20 + 0.5D, where

Q = Design peak flow, gpm
D = Homes served by the system

B. The Department may require that a hydraulic analysis (including pump head calculations and pump curves) be submitted to verify that the system will function as proposed.

4.1.5.6 Small Diameter Gravity Sewer Design

A. Small diameter gravity (SDG) sewers may be used for septic tank effluent only.

B. Hydraulic design must be based upon 1/2 to 3/4 full pipe at peak design flow (Equation B.3-1). A minimum design velocity equal to 1 ft/sec and a Manning roughness coefficient of 0.013 must be used.

C. All SDG sewer piping must be 4-inch diameter pipe or larger.

D. To minimize potential sources of infiltration, 20 foot minimum pipe lengths and in-line service fittings should be used.

4.1.5.7 Septic Tank Effluent Pumps (STEP) and Grinder Pump (GP) Sewer Design

A. One STEP or GP unit must be provided per household. Where multiple family dwellings or trailer courts are served,duplex pumps, each capable of handling maximum flow must be provided~~,~~

B. System hydraulic requirements for STEP systems must be based on a minimum design velocity of 1.0 ft/sec, and a Hazen-Williams friction coefficient of 130 to 140. System hydraulic requirements for GP systems must be based on 2ft/sec, and a Hazen-Williams friction coefficient of 120.

C. Pumping Units

1. STEP and GP units receiving wastewater from private sewers must be provided with pumps and controls that are corrosion resistant and are listed by Underwriters Laboratories, Canadian Standards Association, or other approved testing and/or accrediting agency as meeting the requirements for National Electric Code Class I, Division 2 locations. Submersible pumps and motors must be designed specifically for totally submerged operation and meet the requirements of the National Electric Code for such units. In addition, the design must provide for the pumps and motors to be totally submerged at all times.

2. Pumping units must be activated by appropriate level control switches. High and low level alarms will be required with audio-visual alarms recommended. Low level pump deactivation controls must be provided. A control panel with appropriate circuit protection and electrical safety devices must be used. The alarm circuit should be separately wired from the pump circuit. All applicable electrical codes must be satisfied. The power cables to the pump must be designed for extra-hard usage. Electrical components must be designed to facilitate maintenance of the pumping unit. Wiring must be exterior to the residence for maintenance purposes.

3. Pipe fittings used should be commonly available. Appropriate isolation, check, and air release valves must be used with ease of maintenance in mind. STEP and GP pumping equipment must be serviceable from the surface without requiring operations personnel to enter vaults, tanks or other enclosed spaces.

C. For systems served by a community water system, STEP and GP tanks must have a minimum of 24 hours of storage within the tank. Storage volume is defined as the volume between the pump “off” switch and the invert of the influent line. The engineer must review historical records of the local power provider to determine if the area has a history of prolonged power outages. Where such conditions exist, additional storage requirements or a backup generator may be required by the Department.

D. Inlet pipes to wet wells must be extended below the low water elevation in the wet well in order to reduce turbulence and odors.

E. Each service line between the STEP or GP pump and the collection line must be a minimum of 1-1/4 inch in diameter and have a gate or ball valve installed at the main with a stem and riser to the surface. In addition, a minimum of two check valves must be installed on STEP and GP service lines to prevent surcharge. A check valve integral to either the STEP or GP pump may be one of the check valves.

F. Sufficient mainline valves must be installed at locations to isolate portions of the system and to ensure continuous operation for maintenance and repair.

G. Isolation valves must be placed upstream of where two mains intersect and at the terminal end of the system to facilitate the future extension of the main. Valves must also be installed at railroad crossings, bridge crossings, waterway crossings, and long force main lengths.

H. STEP and GP sewers must be installed with cleanouts (pig ports) at the end of each line and at all line size changes to necessitate cleaning. Cleanouts must be designed to launch a minimum 2 lb/cu-ft polyfoam pig for scouring the pipelines.

~~I.~~ Air relief valves must be placed at high points to prevent air locking. Vacuum relief valves may be necessary to relieve negative pressures on force mains. The force main configuration and head conditions should be evaluated as to the need for and placement of vacuum relief valves.

J. Where air release devices are used, odor control such as activated carbon, soil filters or other odor control must be provided.

K. Leakage tests must be specified including testing methods and leakage limits. Pressure testing of service lines must be completed with the ball valve at the mainline in the closed position. Pressure testing of the mainline must be completed with the service line ball valves in the open position to verify the effectiveness of check valves.

4.1.5.8 Discharge to a Conventional Collection System

Discharge to a conventional gravity system shall be by installing a wye on the gravity main or by connection at a manhole. Drop manholes must not be used. Discharge in a manhole must be accomplished by producing a laminar flow in the manhole channel.

When a STEP or GP system is connected to a conventional force main, the engineer must provide hydraulic calculations that demonstrate the system pump(s) will operate across the expected range of head conditions.

4.1.5.9 Corrosion Control

If required by the receiving wastewater facility owner, the effluent must be conditioned to reduce or eliminate the effects of hydrogen sulfide release. Conditioning may include aeration or chemical addition.

4.1.5.10 Operation and Maintenance

All alternative systems must have an operation and maintenance plan in accordance with Appendix D with the following additions:

A. A responsible authority must assume ownership, operation, and maintenance of the alternative sewer system. This authority should also assume control of servicing individual contributing units or at least coordinating proper servicing by the manufacturer's local service representatives.

B. The wastewater system entity must maintain spare pumps and a supply of spare parts for both individual and central pumping units.

C. An overall system schematic plan showing the number of connections contributing to each reach, pump stations with pump sizing information, pipe routes and sizes, valve locations, etc.),

D. Routine inspection requirements and checklists, operation and maintenance responsibilities (including septic tank maintenance, odor control devices, etc.),

E. Cleaning strategies, trouble-shooting, equipment and component contact information, monitoring and sampling plan for operational purposes and permit requirements, solids handling plan, record keeping, operator safety (including confined space entry and H_2S exposure issues), an emergency response plan, and warranty information.

4.1.6 Collection System Setbacks

4.1.6.1 Stream Crossings

A. The top of all sewers entering or crossing streams must be at a sufficient depth below the natural bottom of the stream bed to protect the sewer. In general, the following cover requirements must be met:

1. One foot (0.3 m) of cover where the sewer is located in rock;

2. Three feet (0.9 m) of cover in other material. In streams with high seasonal flows or streams with an alluvial foundation, more than three feet (~~9~~ 0.9 m) of cover may be required. The engineer must provide scour analysis to justify the bury depth in these cases; and

3. In paved stream channels, the top of the sewer should be placed below the bottom of the channel pavement.

Less cover will be approved only if the proposed sewer crossing will not interfere with the future improvements to the stream channel. Reasons for requesting less cover must be provided in the project proposal.

B. Sewers located along streams must be located outside of the stream bed and sufficiently removed from the stream bed to provide for future possible stream widening and to prevent pollution by siltation during construction.

C. The sewer outfalls, headwalls, manholes, gate boxes, or other structures must be located so they do not interfere with the free discharge of flood flows of the stream.

D. Sewers crossing streams should cross the stream as nearly perpendicular to the stream flow as possible and must be free from change in grade. Sewer systems must be designed to minimize the number of stream crossings. Trenchless construction technologies should be considered for stream crossings to avoid the impacts of open cut construction.

E. Sewers entering or crossing streams must be constructed so they will remain watertight and free from changes in alignment or grade. The use of a casing pipe to carry the sewer is recommended. Crossings constructed of ductile iron or PVC pipe must have restrained mechanical joints when not encased in concrete. When a casing pipe is not utilized for PVC or HDPE pipe, encasement in concrete is required. Material used to backfill the trench must be stone, coarse aggregate, washed gravel, or other materials that will not readily erode, cause siltation, damage pipe during placement, or corrode the pipe.

F. Valves must be provided at both ends of force main crossings so that the section can be isolated for testing and repair. The valves must be easily accessible, and not subject to flooding.

G. Construction methods that will minimize siltation and erosion must be used. The design engineer shall include in the project specifications the method(s) to be employed in the installation of sewers in or near streams. Best management practices (BMP's) must be utilized during construction. Such methods must provide adequate control of siltation and erosion by limiting unnecessary excavation, disturbing or uprooting of trees and vegetation, dumping of soil or debris, or pumping of silt-laden water into the stream. Specifications must require that cleanup, grading, seeding and planting or restoration of all work areas begin immediately after the construction has been completed. Exposed areas may not remain unprotected for more than seven days. Any work proposed in streams, wetlands, floodplains, and other water bodies will require a permit from the appropriate regulatory authority. One or more of the following permits may be required: a 124 permit, issued by the Montana Department of Fish, Wildlife and Parks; 318 Permit issued by DEQ; a 310 Permit issued by the Local Conservation District; a 404 Permit issued by the Corps of Engineers; a Navigable Rivers Land Use License issued by the DNRC; a Floodplain Permit issued by the DNRC or Local Floodplain Administrator. Other permits not listed here may be required.

4.1.6.2 Aerial Crossings

A. Sewers supported by piers across ravines or streams will be allowed only when it can be demonstrated that no other practical alternative exists.

B. Support must be provided for all joints in pipes utilized for aerial crossings. The supports must be designed to prevent frost heave, overturning, and settlement. Precautions against freezing, such as insulation and increased slope, must be provided. Expansion jointing must be provided between aboveground and belowground sewers. Where buried sewers change to aerial sewers, special construction techniques must be used to minimize frost heaving.

C. For aerial stream crossings, the impact of flood waters and debris must be considered. The bottom of the pipe should be placed no lower than the elevation of the 50 year flood. Ductile iron pipe with mechanical joints is recommended.

D. Valves must be provided at both ends of force main crossings so that the section can be isolated for testing and repair. The valves must be easily accessible, and not subject to flooding.

E. Where sewers crossing streams are to be attached to bridge structures, the bridge owner must provide written approval that this approach will not structurally impair the bridge and is acceptable to the owner. The sewer must be attached to the bridge in a manner that protects it from vandalism and provides support as defined above for pier crossing systems. This documentation must be provided with the design submittal.

4.1.6.3 Protection of Water Supplies

A. When wastewater sewers are proposed in the vicinity of any water supply facilities, requirements of Circular DEQ 1, Circular DEQ 3 and ARM Title 17 chapter 36 should be used to confirm acceptable isolation distances. Sewers may not be located within 100 feet of a public water supply well or within 50 feet of all other wells.

B. There may not be any physical connections between a public or private potable water supply system and a sewer, or appurtenance that would permit the passage of any wastewater or polluted water into the potable supply. A water pipe may not pass through or come in contact with any part of a sewer manhole.

C. All existing waterworks units, such as basins, wells, or other treatment units, within 100 feet (31 m) of the proposed sewer must be shown on the engineering plans.

4.1.6.4 Relation to Water Mains

A. Horizontal Separation (Parallel Installation) Water mains must be laid at least 10 feet horizontally from any existing or proposed gravity sanitary or storm sewer, septic tank, or subsoil treatment system. The distance must be measured edge to edge. If the proper horizontal separation as described above cannot be obtained, the design engineer shall submit a request for a deviation along with a description of the problem and justifying circumstances. If the deviation is granted, the sewer must be designed and constructed with the following minimum conditions:

1. Sewers must be constructed of slip-on or mechanical joint pipe complying with public water supply design standards (DEQ 1) and be pressure tested to minimum 150 psi to assure watertightness, and,

2. Sewer services utilizing in-line fittings and extending to at least property lines must be installed and tested within 10 feet of the encroachment. Saddles are not acceptable

B. Vertical Separation: Sewer mains crossing water mains must be laid with a minimum vertical separation distance of 18 inches between the outside of the water main and the outside of the sewer. This must be the case where the water main is either above or below the sewer. The crossing must be arranged so that the sewer joints will be equidistant and as far as possible from the water main joints. Where a water main crosses under a sewer, adequate structural support must be provided for the sewer to maintain line and grade and to prevent damage to the water main.

If the proper vertical separation as described above cannot be obtained, the design engineer may design the crossing with the following minimum conditions:

1. Vertical separation at crossings between water and sewer mains must be at least 6 (six) inches.

2. Sewers must be constructed of slip-on or mechanical joint pipe

complying with public water supply design standards (DEQ 1) and be pressure tested to minimum 150 psi to assure watertightness.

3. At crossings, one standard length of new pipe must be centered at approximately a 90 degree angle in respect to the existing pipe.

4. Sewer services utilizing in-line fittings and extending to at least property lines must be installed and tested within 10 feet of the crossing. Saddles are not acceptable.

5. Either the water or sewer main must be encased in a watertight carrier pipe which extends 10 feet (3m) on both sides of the crossing or the mains must be encased in a minimum of 6 inches of flowable fill for a minimum of 10 feet each side of the crossing pipes.

If the minimum 6 (six) inch separation is not viable, the water line must be relocated, and vertical separation at crossings between water and sewer mains must be at least 18 (eighteen) inches

4.2 PUMPING SYSTEMS

4.2.1 General

This chapter describes pumping systems and appurtenances for both raw wastewater and effluent.

4.2.2 Raw Wastewater Pumping Stations

4.2.2.1 The standards in Section 4.2.2 apply in full to pumping stations receiving raw wastewater that have design flow rates of 5,000 gpd or greater.

4.2.2.2 The standards in Section 4.2.2 apply to pumping stations receiving raw wastewater that have design flow rates less than 5,000 gpd, with the following exceptions.

A. Pumps must be capable of passing spheres of at least 2 inches in diameter, or grinder pumps capable of handling raw wastewater must be provided.

B. Submersible pumps and motors must be designed specifically for totally submerged operation and must meet the requirements of the National Electric Code for such units. In addition, the design must provide for the pumps and motors to be totally submerged at all times.

C. Multiple pumps are not required.

D. Pump suction and discharge piping may be less than 4 inches in diameter.

4.2.2.3 Location, Safety, and Access

A. Wastewater pumping station structures and electrical and mechanical equipment must be protected from physical damage by the 100 year flood. Wastewater pumping stations should remain fully operational and accessible during the 25 year flood. Regulations of state and federal agencies regarding floodplain obstructions must be followed.

B. The pumping station must be readily accessible by maintenance vehicles during all weather conditions. The facility should be located off the traffic way of streets and alleys. It is recommended that security fencing and access hatches with locks be provided.

C. Adequate provision must be made to effectively protect maintenance personnel from hazards. Equipment for confined space entry in accordance with OSHA the State of Montana Department of Labor and Industy,and regulatory agency requirements must be provided for all wastewater pumping stations.

D. Dry wells and valve vaults, including their superstructure, must be separated from the wet well. Common walls must be gastight.

E. Provision must be made to facilitate removing pumps, motors, and other mechanical and electrical equipment. Individual pump and motor removal must not interfere with the continued operation of remaining pumps.

F. Suitable and safe means of access for persons wearig self-contained breathing apparatus must be provided to dry wells, and to wet wells .

G. For built-in-place pump stations, a stairway or ladder to the dry well must be provided with rest landings at vertical intervals not to exceed 12 feet (3.7 m). For factory-built pump stations over 15 feet (4.6 m) deep, rigidly fixed landings must be provided at vertical intervals not to exceed 10 feet (3 m). Where a landing is used, a suitable and rigidly fixed barrier must be provided to prevent an individual from falling past the intermediate landing to a lower level. A manlift or elevator may be used in lieu of landings in a factory-built station, provided emergency access is included in the design. Where ladders are used, adherence to federal safety standards is mandatory.

4.2.2.4 Design

A. Where high groundwater conditions are anticipated, buoyancy calculations for the wastewater pumping station structures must be considered and, if necessary, adequate provisions must be made for protection.

B. Wastewater pumping stations must be constructed with materials that are capable of withstanding prolonged exposure to hydrogen sulfide and other corrosive gases, greases, oils, and other constituents frequently present in wastewater. This is particularly important in the selection of metals and paints. Contact between dissimilar metals should be avoided. If dissimilar metals are used, construction methods must minimize galvanic action through other means.

4.2.2.5 Pumps and Pneumatic Ejectors

A. Multiple pumps or ejector units must be provided. Where only two units are provided, they must be of the same size. Units must have capacity such that, with any unit out of service, the remaining units will have capacity to handle the design peak hourly flow.

B. Pumps handling combined wastewater must be preceded by readily accessible bar racks to protect the pumps from clogging or damage. Where a bar rack is provided, a mechanical hoist must also be provided. Where the size of the installation warrants, mechanically cleaned and/or duplicate bar racks must be provided.

C. Pumps handling separate sanitary wastewater from 30 inch (762 mm) or larger diameter sewers must be protected by bar racks meeting the above requirements. Appropriate protection from clogging must also be considered for small pumping stations.

D. Pumps handling raw wastewater must be capable of passing spheres of at least 3 inches (76 mm) in diameter except for grinder pumps which must be capable of passing spheres of at least 1 inch (25.4 mm) in diameter. Pump suction and discharge piping must be at least 4 inches (102 mm) in diameter except for grinder pumps, openings must meet the pump manufacturers requirements for the expected wastewater.

E. The pump must be placed so that under normal operating conditions it will operate under a positive suction head, except as specified for suction lift pumps.

F. Electrical systems and components (e.g., motors, lights, cables, conduits, switch boxes, control circuits, etc.) in raw wastewater wet wells, or in enclosed or partially enclosed spaces where hazardous concentrations of flammable gases or vapors may be present, must comply with the National Electrical Code requirements for Class I Group D, Division 1 locations. In addition, equipment located in the wet well must be suitable for use under corrosive conditions. Each flexible cable must be provided with watertight seal and separate strain relief. A fused disconnect switch located above ground must be provided for the main power feed for all pumping stations. When such equipment will be exposed to weather, it must meet the requirements for weatherproof equipment in NEMA 3R or 4. A 110 volt power receptacle to facilitate maintenance must be provided inside the control panel for lift stations that have control panels outdoors. Ground fault interruption protection must be provided for all outdoor outlets.

G. Each pump must have an individual intake. Wet well and intake design must avoid turbulence near the intake and prevent vortex formation.

H. A sump pump equipped with dual check valves must be provided in the dry well to remove leakage or drainage, with discharge above the maximum high water level of the wet well. Water ejectors connected to a potable water supply will not be approved. All floor and walkway surfaces should have an adequate slope to a point of drainage. Pump seal leakage must be piped or channeled directly to the sump. The sump pump must be sized to remove the maximum pump seal water discharge that would occur from a pump seal failure. An alarm must be activated upon sump pump failure.

I. The pumps and controls of main pumping stations especially pumping stations operated as part of the treatment facility should be selected to operate at varying delivery rates. Insofar as is practicable, such stations should be designed to deliver as uniform a flow as practicable in order to minimize hydraulic surges. The station design peak hourly flow capacity must be designed to handle the peak hourly flow and must be adequate to maintain a minimum cleaning velocity of 2 feet per second (0.61 m/s) in the force main.

J. Control float tubes, bubbler lines, or other controls should be located so as not to be unduly affected by turbulent flows entering the well or by the turbulent suction of the pumps. Bubbler type level monitoring systems must include dual air compressors. Provision must be made to automatically alternate the pumps in use. Suction lift stations must be designed to alternate pumps daily instead of each pump cycle to extend the life of the priming equipment.

4.2.2.6 Valves

A. Shutoff valves must be placed on the suction line of dry pit pumps.

B. With the two exceptions of screw pumps and short discharge lines (10 feet or less), shutoff and check valves must be placed on the discharge line of each pump The check valve must be located between the shutoff valve and the pump. Check valves must be suitable for the material being handled and must be placed on the horizontal portion of discharge piping, except for ball checks, flapper swing check valves, or flexible disk check valves (body seat constructed at an angle of 45 degrees to the flow line), which may be placed in the vertical run. Valves must be capable of withstanding normal pressure and water hammer.

C. All shutoff and check valves must be operable from the floor level and accessible for maintenance. Outside levers are recommended on swing check valves.

4.2.2.7 Wet Wells

A. Where continuity of pumping station operation is critical, consideration should be given to dividing the wet well into two sections, properly interconnected, to facilitate repairs and cleaning.

B. Pump stations must be designed to operate under the full range of projected system hydraulic conditions, and should have the flexibility to accommodate project phasing if proposed.

The design fill time and minimum pump cycle time must be considered in sizing the wet well. The effective volume of the wet well must be based on design average flow and a filling time not to exceed 30 minutes unless the facility is designed to provide flow equalization. The pump manufacturer's duty cycle recommendations must be utilized in selecting the minimum cycle time. When the anticipated initial flow tributary to the pumping station is less than the design average flow, provisions should be made so the fill time indicated is not exceeded for initial flows. When the wet well is designed for flow equalization as part of a treatment ~~plant~~ facility, provisions should be made to prevent septicity.

For constant speed pumps, the minimum volume between pump on and pump off levels can be calculated using

$$t = \frac{4V}{Q}$$

t = minimum time between pump starts (minutes)

V = wet well volume (gallons)

Q = pump capacity (gallons per minute)

B. The wet well floor must have a slope of at least 1 to 1 to the hopper bottom. The horizontal area of the hopper bottom may not be greater than necessary for proper installation and function of the inlet.

4.2.2.8 Safety Ventilation

A. Covered wet wells must have provisions for air displacement such as an inverted "j" tube or other means that vents to the outside.

B. Adequate ventilation must be provided for all pump stations. Where the dry well is below the ground surface, permanent mechanical ventilation is required. If screens or mechanical equipment requiring maintenance or inspection are located in the wet well, permanently installed ventilation is required. There may not be any interconnection between the wet well and dry well ventilation systems.

C. In dry wells over 15 feet (4.6 m) deep, multiple inlets and outlets are desirable. Dampers should not be used on exhaust or fresh air ducts and fine screen or other obstructions in air ducts should be avoided to prevent clogging.

D. Switches for operation of ventilation equipment should be marked and located conveniently. All intermittently operated ventilation equipment must be interconnected with the respective pit lighting system.

E. Consideration should be given also to automatic controls where intermittent operation is used. The manual lighting/ventilation switch must override the automatic controls. For a two-speed ventilation system with automatic switch-over and gas detection equipment, consideration should be given to increasing the ventilation rate automatically in response to the detection of hazardous concentrations of gases or vapors.

F. The fan wheel should be fabricated from non-sparking material. Automatic heating and dehumidification equipment must be provided in all dry wells.

G. Wet well ventilation may be either continuous or intermittent. Ventilation, if continuous, must provide at least 12 complete air changes per hour; if intermittent, at least 30 complete air changes per hour must be provided.

Air must be forced into the wet well by mechanical means rather than exhausted from the wet well. The air change requirements must be based on 100 percent fresh air. Portable ventilation equipment must be provided for use at submersible pump stations and wet wells with no permanently installed ventilation equipment.

H. Dry well ventilation may be either continuous or intermittent. Ventilation, if continuous, must provide at least 6 complete air changes per hour; if intermittent, at least 30 complete air changes per hour must be provided.

A system of two speed ventilation with an initial ventilation rate of 30 changes per hour for 10 minutes and automatic switch over to 6 changes per hour may be used to conserve heat.

I. Suitable devices for measuring wastewater flow should be considered at all pumping stations. Indicating, totalizing, and recording flow measurements and voltage/ampere meters must be provided at pumping stations with a 1200 gpm (76 L/s) or greater design peak flow. Elapsed time meters must be provided for all pumps. Flow meters must be installed when recommended by the manufacturer. A pressure gage should be provided.

J. There may not be any physical connection between any potable water supply and a wastewater pumping station that under any conditions might cause contamination of the potable water supply. If a potable water supply is brought to the station, either a combination of a break tank, pressure pump, and pressure tank must be used, or a backflow preventer device or assembly must be installed. Water must be discharged to the break tank through an air gap at least 6 inches (15.2 cm) above the flood line or the spill line of the tank, whichever is higher. Air gaps and backflow preventer valves must be constructed in accordance with Montana statutes and rules.

K. A sign must be permanently posted at every hose bib, faucet, hydrant, or sill cock located on the water system beyond the break tank or approved backflow preventer valve or assembly to indicate that the water is not safe for drinking.

4.2.2.9 Suction Lift Pump Station

A. Suction lift pumps must be of the self-priming or vacuum-priming type and must meet the applicable requirements of this chapter. Suction-lift pump stations using dynamic suction lifts exceeding the limits outlined in the following sections may be approved upon submission of factory certification of pump performance and detailed calculations indicating satisfactory performance under the proposed operating conditions. Such detailed calculations must include static suction-lift as measured from "lead pump off" elevation to center line of pump suction, friction, and other hydraulic losses of the suction piping, vapor pressure of the liquid, altitude correction, required net positive suction head, and a safety factor of at least 6 feet (1.8 m).

B. Self-priming pumps must be capable of rapid priming and repriming at the "lead pump on" elevation. Such self-priming and repriming must be accomplished automatically under design operating conditions. Suction piping should not exceed the size of the pump suction and may not exceed 25 feet (7.6 m) in total length. Priming lift at the "lead pump on" elevation must include a safety factor of at least 4 feet (1.2 m) from the maximum allowable priming lift for the specific equipment at design operating conditions. The combined total of dynamic suction lift at the "pump off" elevation and required net positive suction head at design operating conditions may not exceed 22 feet (6.7 m).

C. Vacuum-priming pump stations must be equipped with dual vacuum pumps capable of automatically and completely removing air from the suction-lift pump. The vacuum pumps must be adequately protected from damage due to wastewater. The combined total of dynamic suction-lift at the "pump off" elevation and required net positive suction head at design operating conditions may not exceed 22 feet (6.7 m).

D. The pump equipment compartment must be above grade or offset and must be effectively isolated from the wet well to prevent the humid and corrosive sewer atmosphere from entering the equipment compartment. Wet well access may not be through the equipment compartment and must be at least 24 inches (610 mm) in diameter. Gasketed replacement plates must be provided to cover the opening to the wet well for pump units removed for servicing. Valving may not be located in the wet well.

4.2.2.10 Submersible Pump Station

A. Submersible pump stations must meet the applicable requirements of this chapter. Submersible pumps and motors must be designed specifically for raw wastewater use, including totally submerged operation during a portion of each pumping cycle, and must meet the requirements of the National Electrical Code for such units. An effective method to detect shaft seal failure or potential seal failure must be provided.

B. Submersible pumps must be readily removable and replaceable without dewatering the wet well or disconnecting any piping in the wet well.

C. Electrical supply, control, and alarm circuits must be designed to provide strain relief and to allow disconnection from outside the wet well. Terminals and connectors must be protected from corrosion by location outside the wet well or through use of watertight seals. If located outside, weatherproof equipment must be used.

D. The motor control center must be located outside the wet well, be readily accessible, and be protected by a conduit seal or other appropriate measures meeting the requirements of the National Electrical Code, to prevent the atmosphere of the wet well from gaining access to the control center. The seal must be located so that the motor may be removed and electrically disconnected without disturbing the seal When such equipment is exposed to weather, it must meet the requirements of weatherproof equipment NEMA 3R or 4.

E. Pump motor power cords must be designed for flexibility and serviceability under conditions of extra hard usage and must meet the requirements of the National Electrical Code standards for flexible cords in wastewater pump stations. Ground fault interruption protection must be used to de-energize the circuit in the event of any failure in the electrical integrity of the cable. Power cord terminal fittings must be corrosion-resistant and constructed in a manner to prevent the entry of moisture into the cable, must be provided with strain relief appurtenances, and must be designed to facilitate field connecting.

F. Valves required under Section 4.2.2.6 must be located in a separate valve chamber. Provisions must be made to remove or drain accumulated water from the valve chamber. Valve pits may be dewatered to a wet well through a drain line with a gas or water tight valve. Check valves that are integral to the pump need not be located in a separate valve chamber provided that the valve can be removed from the wet well in accordance with Section 4.2.2.3.

4.2.2.11 Screw Pump Stations - Special Considerations

A. Screw pumps must meet the applicable requirements of this chapter

B. Covers should be provided.

C. A positive means of isolating individual screw pump wells must be provided.

D. Submerged bearings must be lubricated by an automated system without pump well dewatering

4.2.2.12 Alarms

Alarm systems with a backup power source must be provided for pumping stations. The alarm must be activated upon power failure, sump pump failure, high and low wet well level, pump failure, unauthorized entry, or any cause of pump station malfunction. Shaft seal failure, moisture and thermal sensors shall be provided on submersible pump motors. Redundant low-level alarms~~,~~ should be considered in high hazard environments~~.~~. Pumping station alarms, including identification of the alarm condition, must be transmitted (via telemetry) to a municipal facility that is staffed 24 hours a day. If such a facility is not available and a 24-hour holding capacity is not provided, the alarm must be transmitted to municipal offices during normal working hours and to the home of the responsible person(s) in charge of the lift station during off-duty hours. Audio-visual alarm systems with a self-contained power supply may be acceptable in some cases in lieu of a transmitting system outlined above, depending upon location, station holding capacity and inspection frequency.

4.2.2.13 Emergency Operation

A. The objective of any emergency operation is to prevent the discharge of raw or partially treated wastewater to any waters and to protect public health by preventing back-up of wastewater and subsequent discharge to basements, streets, and other public and private property.

B. Emergency pumping capability is required unless on-system overflow prevention is provided by adequate storage capacity. Emergency pumping capability may be accomplished by connection of the station to at least two independent utility substations, or portable or permanent internal combustion engine equipment that will generate electrical or mechanical energy, or by portable pumping equipment. Such emergency standby systems must have sufficient capacity to start up and maintain the total rated running capacity of the station. A riser from the force main with rapid connection capabilities and appropriate valving must be provided for all lift stations to hook up portable pumps.

C. For use during possible periods of extensive power outages, mandatory power reductions, or emergency conditions, consideration should be given to providing a controlled, high-level wet well overflow to supplement alarm systems and emergency power generation in order to prevent backup of wastewater into basements, or other discharges that may cause severe adverse impacts on public interests, including public health and property damage. Where a high level overflow is utilized, it will be necessary to install a storage/detention tank, or basin, which must be made to drain to the station wet well. It is recommended that a minimum of one hour of storage be provided for peak flow conditions. The reviewing authority may require different storage requirements based on site specific conditions.

D. General Emergency Equipment Requirements

i. These general requirements apply to all internal combustion engines used to drive auxiliary pumps, service pumps through special drives, or electrical generating equipment.

a. The engine must be protected from operating conditions that would result in damage to equipment. Unless continuous manual supervision is planned, protective equipment must be capable of shutting down the engine and activating an alarm on site and as provided in Section 4.2.11. Protective equipment must monitor for conditions of low oil pressure and overheating, except that oil pressure monitoring is not required for engines with splash lubrication.

b. The engine must have adequate rated power to start and continuously operate under all connected loads.

c. Reliability and ease of starting, especially during cold weather conditions, should be considered in the selection of the type of fuel.

d. Design and installation of fuel storage tanks and piping must comply with all state and federal standards.

e. The engine must be located above grade with adequate ventilation of fuel vapors and exhaust gases.

f. All emergency equipment must be provided with instructions indicating the need for regular starting and running of such units at full loads.

g. Emergency equipment must be protected from damage at the restoration of regular electrical power.

ii. Engine-Driven Pumping Equipment

In addition to the general emergency equipment requirements in Section 4.2.2.12.D, these requirements apply to permanently-installed or portable engine-driven pumping equipment.

a. Engine-driven pump(s) must meet the design pumping requirements unless storage capacity is available for flows in excess of pump capacity. Pumps must be designed for anticipated operating conditions, including suction lift if applicable.

b. The engine and pump must be equipped to provide automatic startup and operation of pumping equipment unless manual start-up and operation is justified. Provisions must also be made for manual start-up.

c. Where manual start-up and operation is provided or where part or all of the engine-driven pumping equipment is portable, sufficient storage capacity and an alarm system must be provided to allow time for detection of pump station failure and transportation and hookup of the portable equipment.

iii. Engine-Driven Generating Equipment

In addition to the general emergency equipment requirements in Section 4.2.2.12.D, these requirements apply to permanently-installed or portable engine-driven generating equipment.

a. Generating unit size must be adequate to provide power for pump motor starting current and for lighting, ventilation, and other auxiliary equipment necessary for safety and proper operation of the lift station.

b. The operation of only one pump during periods of auxiliary power supply must be justified. Such justification may be made on the basis of the design peak hourly flows relative to single-pump capacity, anticipated length of power outage, and storage capacity.

c. Special sequencing controls must be provided to start pump motors unless the generating equipment has capacity to start all pumps simultaneously with auxiliary equipment operating.

d. Provisions must be made for automatic and manual start-up and load transfer unless only manual start-up and operation is justified. The generator must be protected from operating conditions that would result in damage to equipment. Provisions should be considered to allow the engine to start and stabilize at operating speed before assuming the load. Where manual start-up and transfer is justified, storage capacity and alarm system must meet the requirements of Section .4.2.2.12.D.iii.e

e. Where portable generating equipment or manual start-up and transfer is provided, sufficient storage capacity and an alarm system must be provided to allow time for detection of pump station failure and transportation and connection of generating equipment. The use of special electrical connections and double throw switches is recommended for connecting portable generating equipment.

iv. Independent Utility Substations

Where independent substations are used for emergency power, each separate substation and its associated transmission lines must be capable of starting and operating the pump stations at its rated capacity

4.2.2.14 Operation and Maintenance

All raw wastewater pumping stations must have an operation and maintenance plan in accordance with appendix D with a complete set of operational instructions, including emergency procedures, maintenance schedules, tools and such spare parts as may be necessary.

4.2.3 Effluent Pumping Stations

Effluent pumping stations process partially treated wastewater from a primary, advanced or other treatment facility.

4.2.3.1 Effluent Pumping Stations for Public Systems

Wastewater pumping stations receiving effluent from public sewers must meet the requirements of Section 4.2.2, with the following exceptions:

A. Pumps other than those capable of passing spheres of at least 3 inches in diameter are acceptable. Screens should be considered where this type of pump is used.

B. The inlet pipe must be extended below the low water elevation in the wet well in order to reduce turbulence and odors.

C. The lift station wet well cover must be watertight for odor control.

D. A vent must be provided with odor control. The vent can be connected to a buried gravel bed or to a charcoal filter.

E. Materials in the wet well must be protected from corrosion. Stainless steel, plastic, or bronze materials are recommended.

4.2.3.2 Effluent Pumping Stations for Individual, Shared and Multiple-User Systems

Wastewater pumping stations receiving effluent from individual and multiple-user systems must meet the following criteria.

A. Wastewater pumping stations must be provided with effluent pumps, controls and wiring that are corrosion-resistant and listed by Underwriters Laboratories, Canadian Standards Association, or other approved testing and/or accrediting agency as meeting the requirements for National Electric Code (NEC) Class I, Division 2 locations. An audible or visible alarm must be provided to indicate failure of the system.

In lieu of meeting the requirements for NEC Class 1, Division 2 locations, pumping stations receiving effluent from five or less living units or non-public commercial units may use submersible pumps and motors designed specifically for totally submerged operation with controls and wiring that are corrosion-resistant and meet the requirements of the National Electric Code.

Pumping tanks or vaults must have audio-visual alarms for high and low water levels. Low level pump deactivation controls must be provided.

B. Pumping Stations Used to Dose Subsurface Absorption Systems

i. Dosing includes both gravity dosing to a distribution box, drop box or manifold and pressure distribution through a manifold to a subsurface absorption system.

ii. Pressure distribution should be utilized whenever practical and must be utilized when the design wastewater flow requires an effective length of more than 500 lineal feet or 1000 square feet of distribution lines. The effective length of the absorption area is the actual length of the trench or bed, calculated prior to any applied reductions and ~~which~~ cannot exceed the length of the pipe by more than one-half the orifice spacing.

iii. Dosing must be accomplished through the use of pumps. Pumps must be sized for the distribution system and justification for the pump selected included for review. ~~may be accomplished with either pumps or siphons. For gravity-dosed systems, the volume of each dose must be at least equal to 75 percent of the internal volume of the distribution lines being dosed.~~

iv. The dose volume of a pressure distribution system must be equal to the drained volume of the transport pipe ~~(pipe leading from the septic tank or dose tank to the distribution lines~~) and manifold, plus a volume that should be 5 to 10 times the net volume of the distribution pipe. Where the system is designed to operate on a timer, more frequent, smaller doses may be used. The minimum dose volume must ~~still~~ be equal to the drained volume of the transport pipe and manifold, plus a volume equal to at least two times the distribution pipe volume. Where timers are used, additional controls are necessary to prevent pump operation at low-water level. For gravity-dosed systems, the volume of each dose must be at least equal to 75 percent of the internal volume of the distribution lines being dosed.

v. The pressure distribution pipe must be at least Schedule 40 PVC or high density polyethylene (HDPE) with a minimum pressure rating of 160 psi. ~~and all~~ All fittings must be pressure rated to the pipe. ~~and at least Class 160 Schedule 40 PVC pipe~~. The pipe must have a single row of orifices 1/8-inch diameter or larger in a straight line. Design must include orifices to allow for drainage of the pipe and to allow air to be expelled from the pipe. Maximum orifice spacing must be 5 feet. The size of the dosing pumps ~~and siphons~~ must be selected to provide a minimum pressure of 2.2 ~~1~~ psi (5 ~~2.3~~ feet of head) at the end of each distribution line. For orifices smaller than 3/16-inch, the minimum pressure must be 4.3 ~~2.16~~ psi (10 ~~5~~ feet of head) at the end of each distribution ~~line~~ pipe.

vi. ~~The duration of each discharge may not exceed 15 minutes to promote uniform distribution~~. A hydraulic analysis demonstrating uniform distribution must be provided for all pressure-dosed systems. The analysis must show no greater than 10 percent variation in distribution of dose across the entire ~~absorption~~ distribution system ~~or sand filter/sand mound or hydraulic zone of absorption system or sand filter/sand mound~~. Pressure dosed systems installed on a sloping site must include means for controlling pressure differences caused by varying distribution pipe elevations across the entire absorption area.

vii. Cleanouts must be provided at the end of every lateral. The cleanouts must be within 6 inches of finished grade and should be made with either a long-sweep elbow or two 45-degree bends. A pressure distribution system designer ~~design engineer~~ may specify the use of capped ends that are replaced after flushing if, in the designer's opinion, this is a more feasible option than long sweep cleanouts. A metal location marker or plastic valve cover must be provided for each cleanout.

a. Dosing tanks

1. Dose tank volumes are not to be included in primary, advanced or other required tank volumes.

2. The reserve storage volume of the dosing tank ~~system~~ must be at least equivalent to 25 percent of the subsurface distribution system design flow. If a duplex pump station is used where each pump doses the entire distribution system, then the reserve storage volume of the dosing tank ~~system~~ may be reduced. The reserve storage volume is computed from the high-level alarm. If the specified pump requires submergence, the tank must also include adequate liquid capacity for pump submergence and the dose volume. The required volume of the dosing

tank must not be considered as any portion of the required volume of the septic tank.

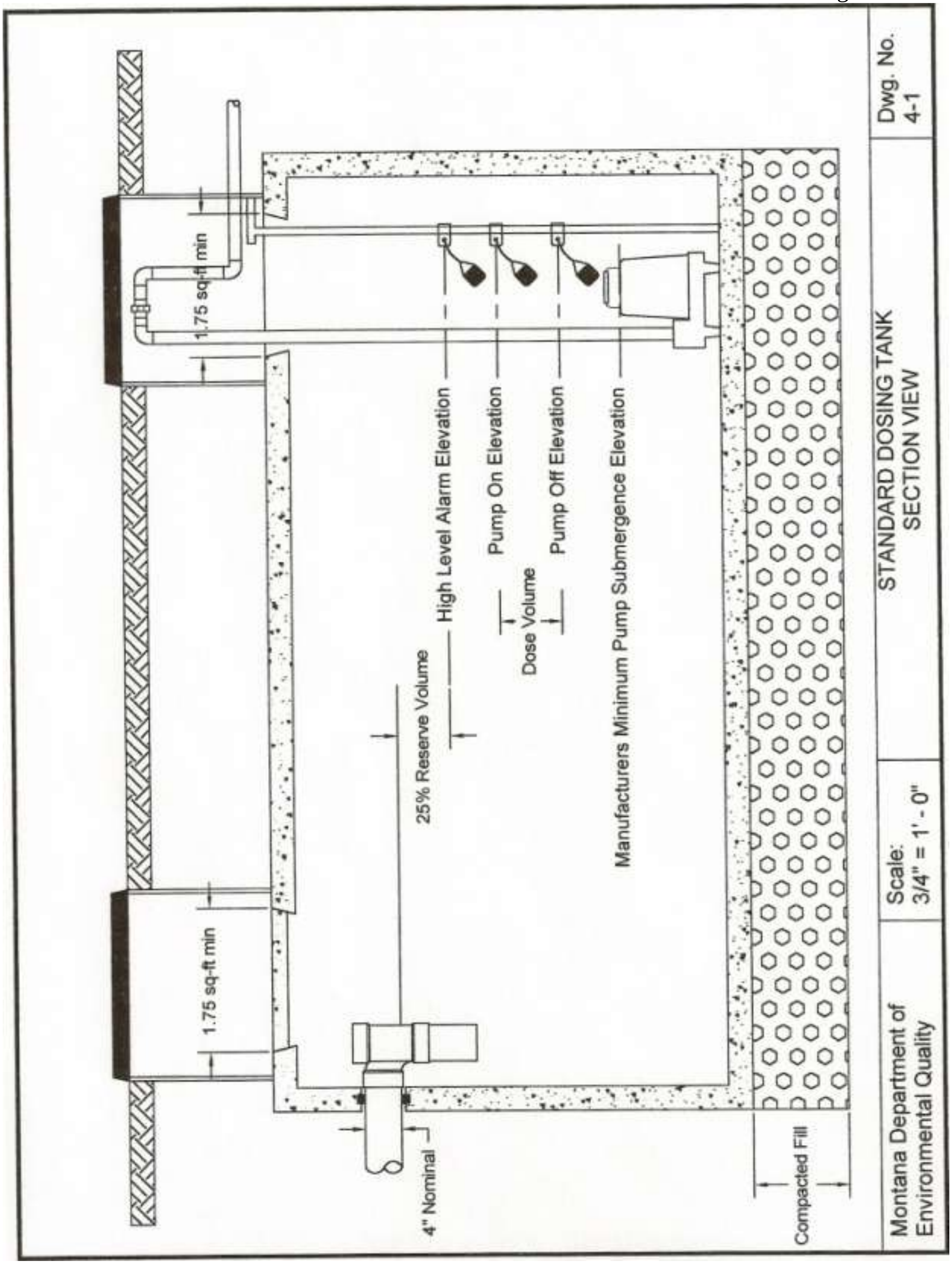
3. The dosing tank must be separated from the septic tank by an air gap to eliminate the possibility of siphoning from the septic tank. Dosing tanks must be provided with access ports sufficiently large to maintain the tank and pumps. Pumps, valves, and other apparatus requiring maintenance must be accessible from the surface without entering the tank or be located in a dry tank adjacent to the wet chamber. The system designer must designate tank depth and riser height prior to installation. Adequate provision must be made to effectively protect maintenance personnel from hazards. If applicable, equipment for confined space entry in accordance with OSHA and regulatory agency requirements must be provided.

~~4.~~ Dosing tanks must meet the material requirements for septic tanks and must be watertight. ~~Dosing tanks utilizing pumps must meet the requirements of Section 6.6.3~~

~~High-water alarms must be provided for all dosing chambers. that utilize pumps.~~

~~Dosed systems using a siphon should have a dose counter installed to check for continued function of the siphon.~~

viii. Pressure distribution systems must be field-tested to verify that the pressure across the entire absorption field does not vary by greater than 10%.~~uniform distribution, which is typically done by a test showing approximately equal squirt height~~


1.75 sq-ft min
1.75 sq-ft min
High Level Alarm Elevation
Pump On Elevation
Pump Off Elevation
Manufacturers Minimum Pump Submergence Elevation
Dose Volume
25% Reserve Volume
4" Nominal
Compacted Fill
STANDARD DOSING TANK
SECTION VIEW
Dwg. No.
4-1
Scale:
3/4" = 1' - 0"
Montana Department of
Environmental Quality

4.3 EFFLUENT DISTRIBUTION SYSTEMS

4.3.1 General

This chapter applies to the transportation of treated effluent to the subsurface absorption and distribution system.

4.3.2 Pipes

4.3.2.1 Transport pipe

Transport pipes move effluent from the primary or advanced treatment system to the distribution box, drop box or manifold.

Pipes leading into and out of septic tanks, advanced treatment system or pumping chamber must have solid walls. Schedule 40 pipe must be used leading ~~into and~~ out of the septic tank, advanced treatment system or pumping chamber in the area of backfill for a minimum length of at least 10 feet.

Pipes that are either 4 or 6 inches in diameter must ~~and~~ have a minimum downward slope of 1/8 inch per foot. Pipes greater than 6 inches in diameter must have a minimum downward slope of 1/4 inch per foot.

Effluent transport lines must be designed to meet the setback requirements for stream crossings, aerial crossings, water supplies and water lines in accordance with Chapter 4.1.6.

4.3.2.2 Distribution pipe materials

A. Gravity-fed distribution lines must be fabricated from 4-inch diameter ASTM D-3034 sewer pipe with perforations per ASTM D-2729.

B. Coiled, perforated-plastic pipe may not be used for distribution pipe within ~~when installing~~ absorption systems. Straight lengths of pipe must be used ~~instead~~.

C. Pipe used for pressure dosed distribution lines must meet ASTM D-1785 or ASTM D-2241. Fittings used in the absorption field must be compatible with the materials used in the distribution pipes. ~~lines~~ Pressure rated fittings must be used for pressure dosed piping.

D. Other distribution pipe materials may be used with prior approval from the reviewing authority.

4.3.3 Distribution Box, Drop Box and Manifold

Distribution boxes, drop boxes and manifolds collect effluent from either primary or advanced treatment systems for distribution in subsurface absorption systems.

~~A manifold must be installed between the septic tank and the absorption trenches.~~ ~~The~~ Distribution boxes, drop boxes and manifolds must be of watertight construction. ~~Distribution boxes may be used in gravity systems in lieu of manifolds.~~ Manifolds used in gravity systems must be set level and arranged so that effluent is distributed to an equal length of distribution pipe on both sides of the junction of the ~~inlet~~ transport pipe to the manifold. Distribution boxes or drop boxes may be used in gravity systems in lieu of manifolds.

4.3.2.1 Distribution boxes must:

~~If a distribution box is used, it must:~~

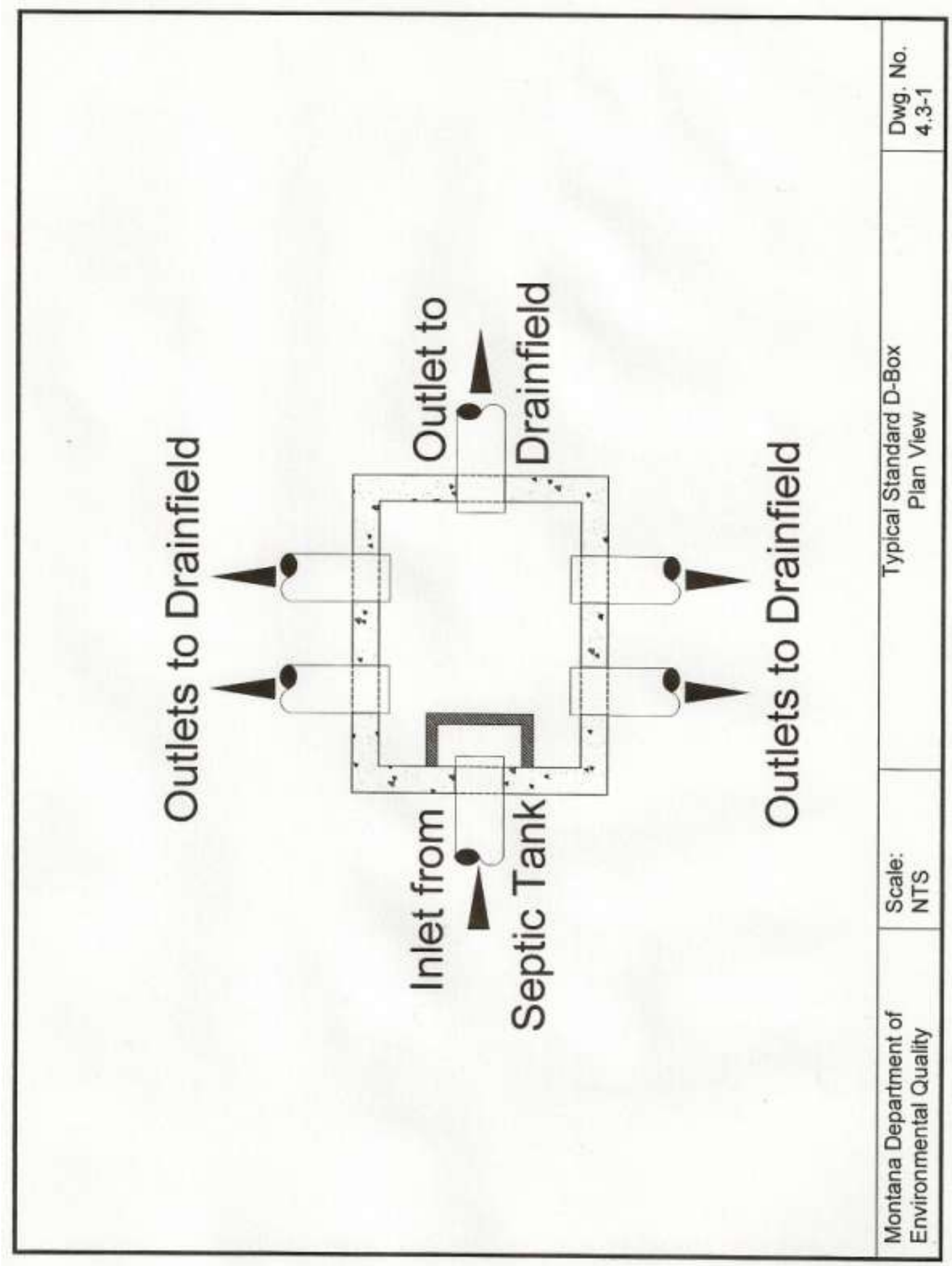
A. be set level and bedded to prevent settling; and,
B. use some flow control or baffling device to ensure equal distribution of effluent; and,
C. be water tested for equal distribution; and,
D. have each outlet serving an equal length of absorption trench; and,
E. if constructed using concrete, the concrete must meet the same requirements as concrete for septic tanks in 5.1.7.1.~~7.2.2~~. Minimum wall, floor, and lid thickness for concrete distribution boxes must be 2 inches; and, ~~Reinforcement is not required for concrete distribution boxes.~~
F. have an access for inspection provided either through a riser or is marked with iron or a suitable, durable marker.

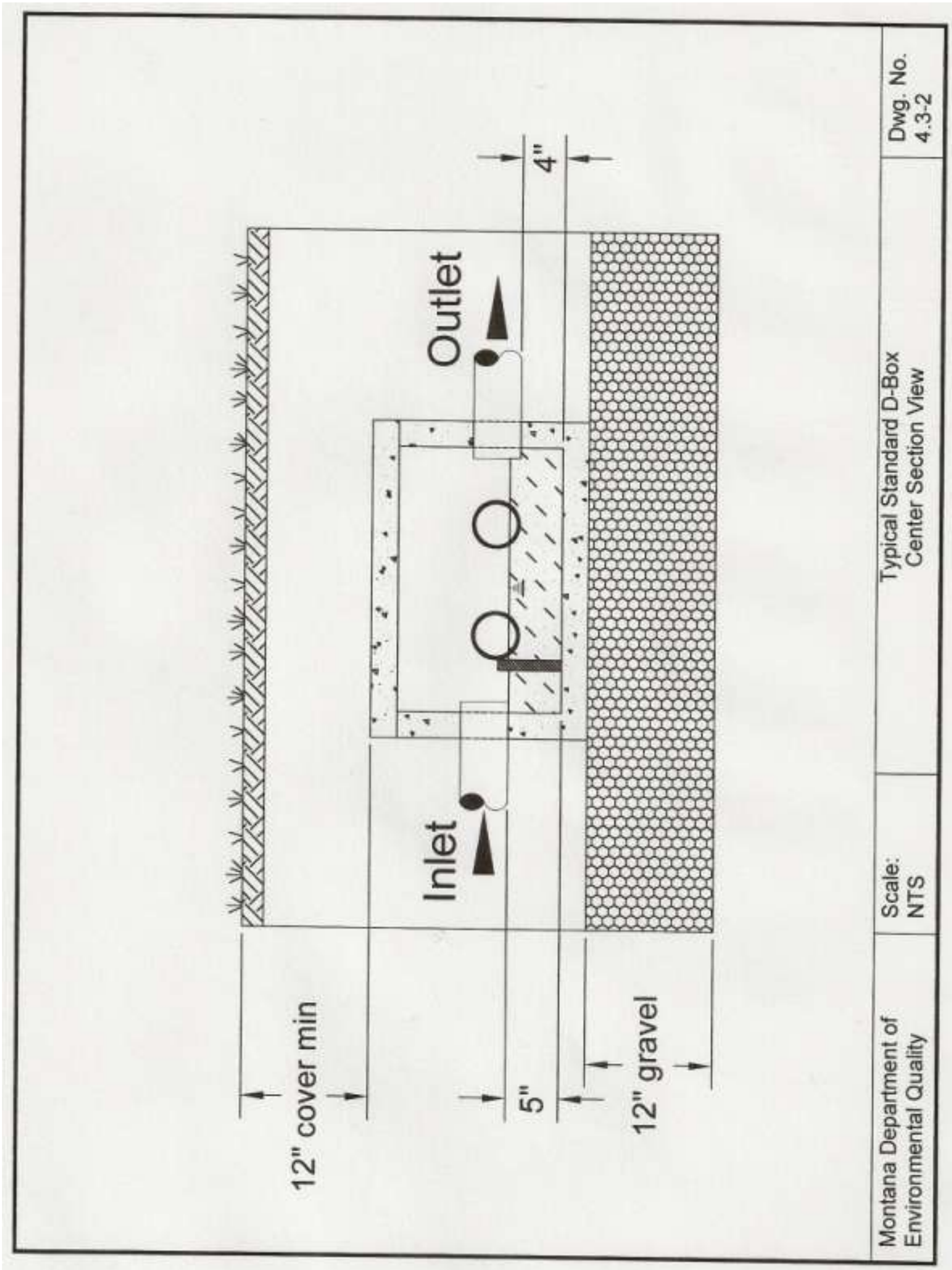
4.3.2.2 Drop boxes must:

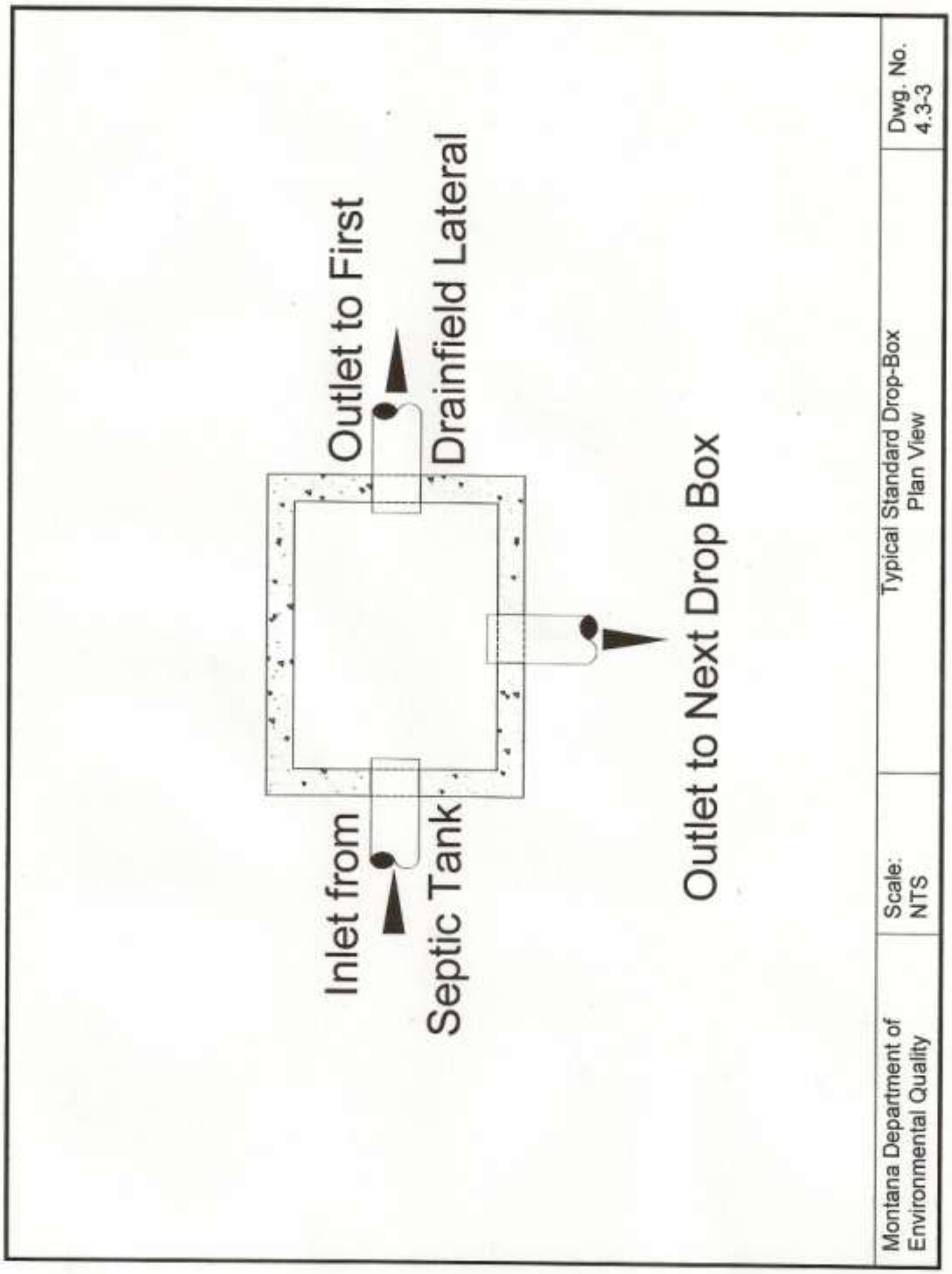
A. Be set level and bedded to prevent settling; and,

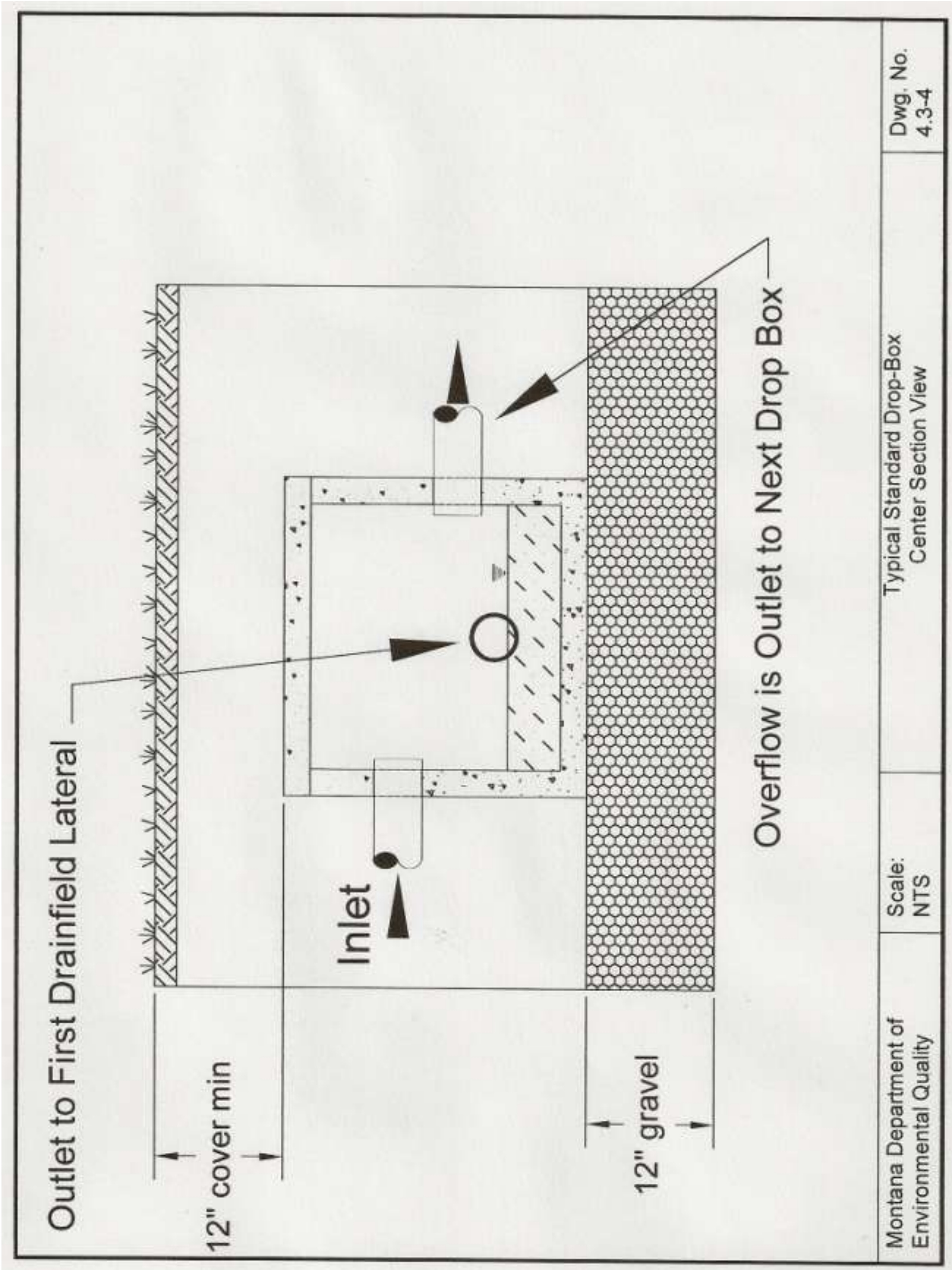
B. if constructed using concrete, the concrete must meet the same requirements as concrete for septic tanks in 5.1.7.1.~~7.2.2~~. Minimum wall, floor, and lid thickness for concrete distribution boxes must be 2 inches; and,

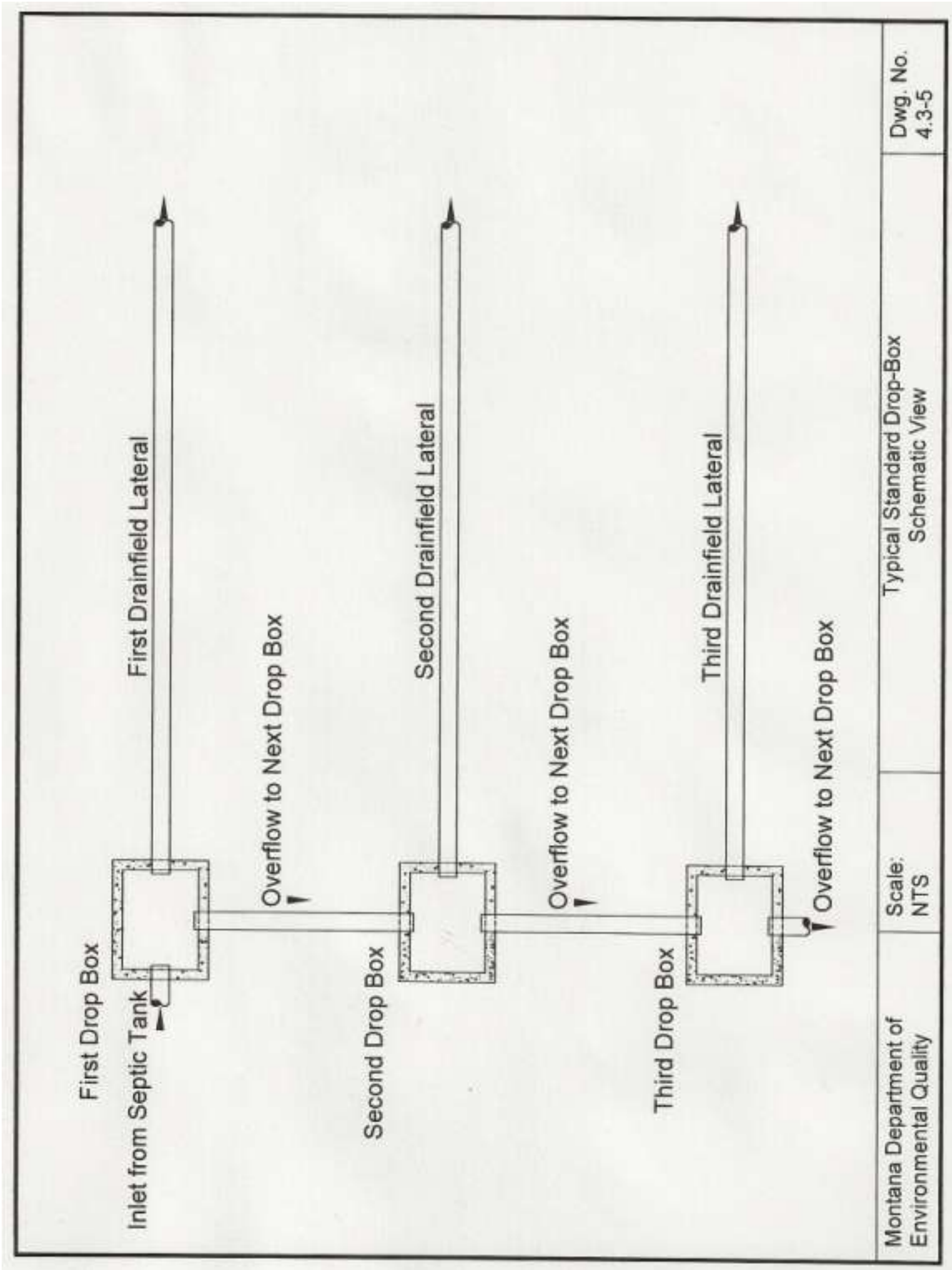
C. have an access for inspection provided either through a riser or is marked with iron or a suitable, durable marker.


Outlets to Drainfield
Outlet to Drainfield
Inlet from Septic Tank
Outlets to Drainfield
Montana Department of Environmental Quality
Scale: NTS
Typical Standard D-Box Plan View
Dwg. No. 4.3-1


12" cover min
5"
12" gravel
4"
Inlet
Outlet
Montana Department of
Environmental Quality
Scale:
NTS
Typical Standard D-Box
Center Section View
Dwg. No.
4.3-2


Outlet to First
Drainfield Lateral
Inlet from
Septic Tank
Outlet to Next Drop Box
Montana Department of
Environmental Quality
Scale:
NTS
Typical Standard Drop-Box
Plan View
Dwg. No.
4.3-3


Outlet to First Drainfield Lateral
12" cover min
12" gravel
Inlet
Overflow is Outlet to Next Drop Box
Montana Department of
Environmental Quality
Scale:
NTS
Typical Standard Drop-Box
Center Section View
Dwg. No.
4.3-4


First Drop Box
Inlet from Septic Tank
First Drainfield Lateral
Overflow to Next Drop Box
Second Drop Box
Second Drainfield Lateral
Overflow to Next Drop Box
Third Drop Box
Third Drainfield Lateral
Overflow to Next Drop Box
Montana Department of
Environmental Quality
Scale:
NTS
Typical Standard Drop-Box
Schematic View
Dwg. No.
4.3-5

5. PRIMARY TREATMENT

5.1 SEPTIC TANKS

~~A septic tank consists of one or more chambers providing primary treatment. All wastewater treatment systems must provide at least primary treatment prior to disposal in an absorption system or sand mound.~~

5.1.1 General

All wastewater must discharge into ~~the~~ a septic tank unless otherwise specifically provided in this Circular.

Roof, footing, garage, surface water drainage, and cooling water must be excluded from the septic tank.

~~The wastewater (backwash) from water softeners may only be discharged to a wastewater treatment system if the installed water softener:~~

~~A. regenerates using a demand-initiated regeneration control device; and~~

~~B. is only connected to interior plumbing for potable water usage and not to exterior irrigation water lines.~~

~~Wastewater from water treatment devices including water softeners, iron filters and reverse osmosis units may not be discharged into an aerobic, nonstandard (excluding elevated sand mounds, intermittent sand filters and recirculating sand filters), or proprietary on-site wastewater treatment system unless the quality and quantity of discharge meets the recommended usage, operation and maintenance specifications of the designer or manufacturer of the system. If such specifications are not available, then approval for the discharge must be obtained from the reviewing authority.~~

~~Wastewater from water treatment devices including water softeners, iron filters and reverse osmosis units may be discharged to a dry well, a separate drainfield with pipe or gravelless chambers or onto the ground if not prohibited by other regulations.~~

The septic tank must be located where it is readily accessible for inspection and maintenance and the bottom should not be deeper than 12 feet from finished grade for ease of pumping and maintenance.

5.1.2 Design

~~Septic tanks must be made of materials resistant to the corrosive environment found in septic tanks. The empty tank must be structurally sound and capable of withstanding~~

~~loads created by 6 feet of burial over the top of the tank. Tanks must be installed in accordance with manufacturer's recommendations.~~

~~The walls and floor of concrete tanks must be at least 3 inches thick if adequately reinforced with steel and at least 6 inches thick if not reinforced. Concrete for septic tanks must have a water/cement ratio less than 0.45, a 28-day compressive strength of 4,000 psi, and must be made with sulfate-resistant cement (tricalcium aluminates content of less than 8 percent).~~

~~Concrete covers must be at least 3 inches thick and adequately reinforced. Access lids must be at least 2 inches thick.~~

5.1.2.1 Liquid connection between compartments ~~shall~~ must consist of a single opening completely across the compartment wall or two or more openings equally spaced across the wall. The total area of openings ~~shall~~ must be at least three times the area of the inlet pipe.

5.1.2.2 A septic tank must provide an air space above the liquid level, which must be equal to or greater than ~~20~~ 15 percent of its liquid capacity. Dose tanks do not need to meet the ~~20~~ 15 percent air space requirement. Each compartment of the septic tank must be vented back to the inlet pipe.

5.1.2.3 Inspection ports measuring at least 8 inches in diameter must be provided above each inlet and outlet and marked with rebar. An access at least 1.75 square feet in size must be provided into each compartment. Each access must be extended to within 12 inches of the finished ground surface. ~~An~~ Access ~~of~~ to the effluent filter ~~of a size~~ must be large enough to maintain the filter ~~must be provided~~ and must be extended to the finished ground surface.

5.1.2.4 The nominal length of the septic tank must be at least twice the width (or diameter) of the tank. Dose tanks are excluded from these length, width, and depth requirements.

5.1.2.5 Septic tanks that have less than or equal to a 5,000-gallon liquid capacity must not use depths greater than 78 inches in computing tank capacity.

5.1.2.6 Septic tanks that have a greater than 5,000-gallon liquid capacity must calculate the maximum liquid depth by dividing the liquid length by a factor of 2.5.

5.1.3 Inlets

5.1.3.1 The inlet into the tank must be at least 4 inches in diameter and enter the tank 3 inches above the liquid level. The inlet connection must be watertight.

5.1.3.2 The inlet of the septic tank and each compartment must be submerged by means of a vented tee or baffle. Tees and baffles must extend below the liquid level to a depth where at least 10 percent of the tank's liquid volume is above the bottom of the tee or baffle.

5.1.3.3 Vented tees or baffles must extend above the liquid level a minimum of 7 inches.

5.1.3.4 Baffle tees must extend horizontally into the tank to the nearest edge of the riser access to facilitate baffle maintenance.

5.1.4 Outlets

5.1.4.1 Outlets must include an effluent filter complying ~~approved by the reviewing authority and complying~~ with Section 5.1.5 ~~7.2.7 below.~~ ~~On~~ A combination septic/dosing tanks~~,~~ ~~the septic tank~~ outlet is considered to be in the wall dividing the septic compartment(s) and the dosing compartment. Septic tanks aligned in series require an effluent filter only on the final outlet.

5.1.4.2 The outlet of the tank must be at least 4 inches in diameter. The outlet connection must be watertight.

5.1.4.3 Each compartment of the septic tank must be vented to the atmosphere.

5.1.4.4 ~~Effluent filter inlets must be located below the liquid level at a depth where 30 to 40 percent of the tank's liquid volume is above the intake of the filter.~~

5.1.5 Effluent filters

5.1.5.1 Effluent filters must be used in all systems. ~~prior to secondary treatment devices~~. ~~unless the reviewing authority approves another filtering device such as a screened pump vault. The effective opening in the effluent filter must be no larger than 1/8-inch.~~

~~The minimum filter must provide a minimum clean water flow rate of 4.2 gallons per minute when tested in a setup that places the filter in its operation position and the clean water head is at the center of a 4-inch sewer line at the septic tank inlet.~~

5.1.5.2 All septic tank effluent must pass through the effluent filter. No by-pass capability may be designed into the effluent filter. A high-water alarm should be installed to signal that the filter has clogged and needs maintenance.

5.1.5.3 Effluent filter inlets must be located below the liquid level at a depth where 30 to 40 percent of the tank's liquid volume is above the intake of the filter.

5.1.5.4 The effluent filter must be secured so that inadvertent movement does not take place during operation or maintenance. Filters must be readily accessible to the ground surface and the handle must extend to within 2 inches of the access riser lid to facilitate maintenance.

~~Openings developed by penetration, saw cut, or equivalent must be process controlled and all mold flash and penetration burrs removed.~~

~~The effluent filter material must be designed such that the filtering medium maintains structural integrity throughout the life of the device. The filter medium must not tear or otherwise distort so as to make the filter inoperable during normal operation. The entire filter must be constructed of proven corrosion resistant material for use in wastewater applications.~~

5.1.5.5 The effluent filter manufacturer must provide documentation ~~that shows at least three years successful field-testing and operation or~~ that the filter meets the design standard for effluent filters in ANSI/NSF Standard 46. ~~The documentation must show the effluent filter has continuously lowered the Total Suspended Solids (TSS) by a minimum of 30 percent and that under normal use the filter is capable of obtaining a minimum of 3 years between maintenance intervals.~~

5.1.5.6 The effluent filter manufacturer must provide installation and maintenance instructions with each filter. The installer must follow the manufacturer's instructions when installing the filter and must use the manufacturer's recommendations for sizing and application. The installer must provide the owner of the system with a copy of the maintenance instructions.

~~The effluent filter manufacturer must certify to the reviewing authority that the filter meets the requirements of this standard.~~

~~A septic tank must provide an air space above the liquid level, which will be equal to or greater than 20 percent of its liquid capacity. Dose tanks do not need to meet the 20 percent air space requirement. Each compartment of the septic tank must be vented back to the inlet pipe.~~

~~Inspection ports measuring at least 8 inches in diameter must be provided above each inlet and outlet and marked with rebar. An access at least 1.75 square feet in size must be provided into each compartment. Each access must be extended to within 12 inches of the finished ground surface. An access of to the effluent filter of a size large enough to maintain the filter must be provided and must be extended to the finished ground surface.~~

5.1.6 Sizing of septic tanks

~~Minimum capacities are:A~~ The ~~minimum acceptable size of septic tank is 1,000 gallons per living unit for any residential system~~. Septic tanks must meet the following minimum size requirements.

Two single compartment tanks may be connected in series to meet ~~the~~ minimum capacity requirements. Dose tank or other tank volumes included in the design may not be included in the required septic tank minimum capacity. The reviewing authority may have additional maintenance requirements for tanks connected in series or those systems utilizing grinder pump.

5.1.6.1 For residential flows :

A. Residential septic tanks serving an individual living unit must be sized in accordance with the number of bedrooms as described below:

1. For 1 to 3 bedrooms, the minimum size septic tank is 1,000 gallons per living unit.
2. For 4 to 5 bedrooms, the minimum size septic tank is 1,500 gallons per living unit.
3. For 6 to 7 bedrooms, the minimum size septic tank is 2,000 gallons per living unit.
4. For 8 or more bedrooms, the minimum size septic tank is 2,000 gallons per living unit plus 250 gallons for each bedroom greater than 7 bedrooms (i.e. 8 bedrooms requires a 2,250 gallon tank; 9 bedrooms requires a 2,500 gallon tank).

B. When the number of living units on a single or common septic tank is between 2 and 9, the minimum septic tank size will be based on the number of living units and corresponding bedrooms as described in Section 5.1.6.1.

C. When the number of living units on a single or common septic tank is 10 or greater, the septic tank must have a capacity of at least 3 times the design flow.

5.1.6.2 For non-residential flows:

A. The minimum acceptable septic tank size is 1,000 gallons for any non-residential system and must have a minimum tank capacity of 3 times the design flow.

~~For non-residential flows less than or equal to 1,500 gallons per day, the tank must have a capacity of at least 2.7 times the design flow.~~

~~For non-residential flows of greater than 1,500 gallons per day, the tank must have a minimum capacity equal to 2.25 times the average daily flow.~~

~~A. For a septic tank less than or equal to 5,000-gallon liquid capacity, depths greater than 78 inches must not be used in computing tank capacity.~~

~~B. For the septic tank greater than 5,000-gallon liquid capacity, the maximum liquid depth is determined by dividing the liquid length by a factor of 2.5.~~

~~Septic tank volume may be sized using nationally recognized plumbing codes, provided that there is adequate volume to store at least 3.5 times the estimated daily wastewater flow, and the sizing is approved by the reviewing authority.~~

~~The nominal length of the septic tank must be at least twice the width (or diameter) of the tank. Dose tanks are excluded from these length, width, and depth requirements.~~

~~Grease traps~~

~~Establishments such as restaurants that produce grease exceeding the limits of residential strength wastewater must be provided with grease traps and meet the requirements of Section 5.4.~~

5.1.7 Construction

5.1.7.1 Concrete Tanks (cast in place tanks and pre-cast tanks)

All concrete tanks must comply with Sections 1, 2, 3, 5 and 6 of ASTM C 1227-09 with the following additional requirements:

A. All concrete tanks must be manufactured with ASTM C 150 Type I, Type I-II or Type V cement and must be made with sulfate-resistant cement (tricalcium aluminates content of less than 8 percent).

B. All concrete tanks must be watertight. Tanks used for commercial facilities, multiple-user systems, public systems or those with a design flow of 700 gallons per day or greater must be tested in place for water tightness using a water pressure test or vacuum test. The reviewing authority or designer may require tanks intended for other uses to be tested. Tanks must be tested using one of the following methods:

i. Vacuum testing - Seal the empty tank and apply a vacuum to 4-in. (100-mm) mercury. The tank is approved if 90% of vacuum is held for 2 minutes; or

ii. Water pressure testing – seal the tank, fill with water and let stand for at least 24 hours. Refill the tank. The tank is approvable if it holds water.

C. Repairs of all concrete tanks, when required, must be performed by the manufacturer in a manner ensuring that the repaired structure will conform to the requirements of this Circular.

D. All concrete tank sealants must be flexible sealants employed in the manufacture or installation of tanks sand must conform to ASTM C 990.

E. Pre-cast concrete tanks

A set of complete plans stamped by a professional engineer to certify compliance with this Circular must be on file with the tank manufacturer and made available to the reviewing authority upon request. These plans must show maximum depth of bury, all dimensions, capacities, reinforcing, structural calculations and other such pertinent data for each tank model.

The precast concrete tank manufacturer shall develop manufacturer's recommended installation instructions for each tank model. The manufacturer shall provide a copy of the stamped drawings along with the installation instructions to each tank purchaser.

All precast concrete tanks must be clearly marked within 2 feet of the outlet with the name of the tank manufacturer, tank model (number of gallons), date of manufacture and maximum depth of bury.

F. Cast-in-place concrete tanks

A complete set of plans stamped by a professional engineer to certify compliance with this Circular and ACI 318 must be provided to the reviewing authority. These plans must show maximum depth of bury, all dimensions, capacities, reinforcing, structural calculations and other such pertinent data. The approved stamped plans must be given to the tank purchaser. As-built plans and a letter of certification from a professional engineer must be submitted to the reviewing authority within 90 days of construction of all cast-in-place concrete tanks.

5.1.7.2 Polyethylene and fiberglass tanks

A set of complete plans stamped by a professional engineer to certify compliance with this Circular and IAMPO/ANSI Z1000 must be on file with the tank manufacturer and made available to the reviewing authority upon request. These plans must show maximum depth of bury, all dimensions, capacities, reinforcing, structural calculations and other such pertinent data for each tank model.

The polyethylene and fiberglass tank manufacturer shall develop manufacturer's recommended installation instructions for each tank model. The manufacturer shall provide a copy of the stamped drawings along with the installation instructions to each tank purchaser.

All polyethylene and fiberglass tanks must be clearly marked within 2 feet of the outlet with the name of the tank manufacturer, tank model (number of gallons), date of manufacture and maximum depth of bury.

Tanks used for commercial facilities, multiple-user systems, public systems or those with a design flow of 700 gallons per day or greater must be tested in place for water tightness. The reviewing authority or designer may require tanks intended for other uses to be tested. For pressure testing a fiberglass or polyethylene tank, all inlets, outlets, and access ports must be sealed and adequately secured. The tank must be charged with 5 psig (3 psig for a 12-foot or larger diameter tank). Tank pressure must be allowed to stabilize. The air supply must be disconnected. If there is any noticeable pressure drop in 1 hour, the tank must be rejected or repaired. After repair, the test must be repeated. Air must be carefully released through an appropriate valve mechanism.

5.1.8 Installation

All septic tanks must be installed per the manufacturer's recommendations.

~~7.5 Water Testing~~

~~7.5.1 All tanks must be watertight. All tanks used for commercial facilities, multiple-user systems or public systems (greater than 700 gpd design flow) must be tested in place for water tightness. Water tightness testing for a concrete tank may be conducted using a water test or vacuum test. Water tightness testing for a fiberglass tank may be conducted using a water test, a vacuum test, or a pressure test.~~

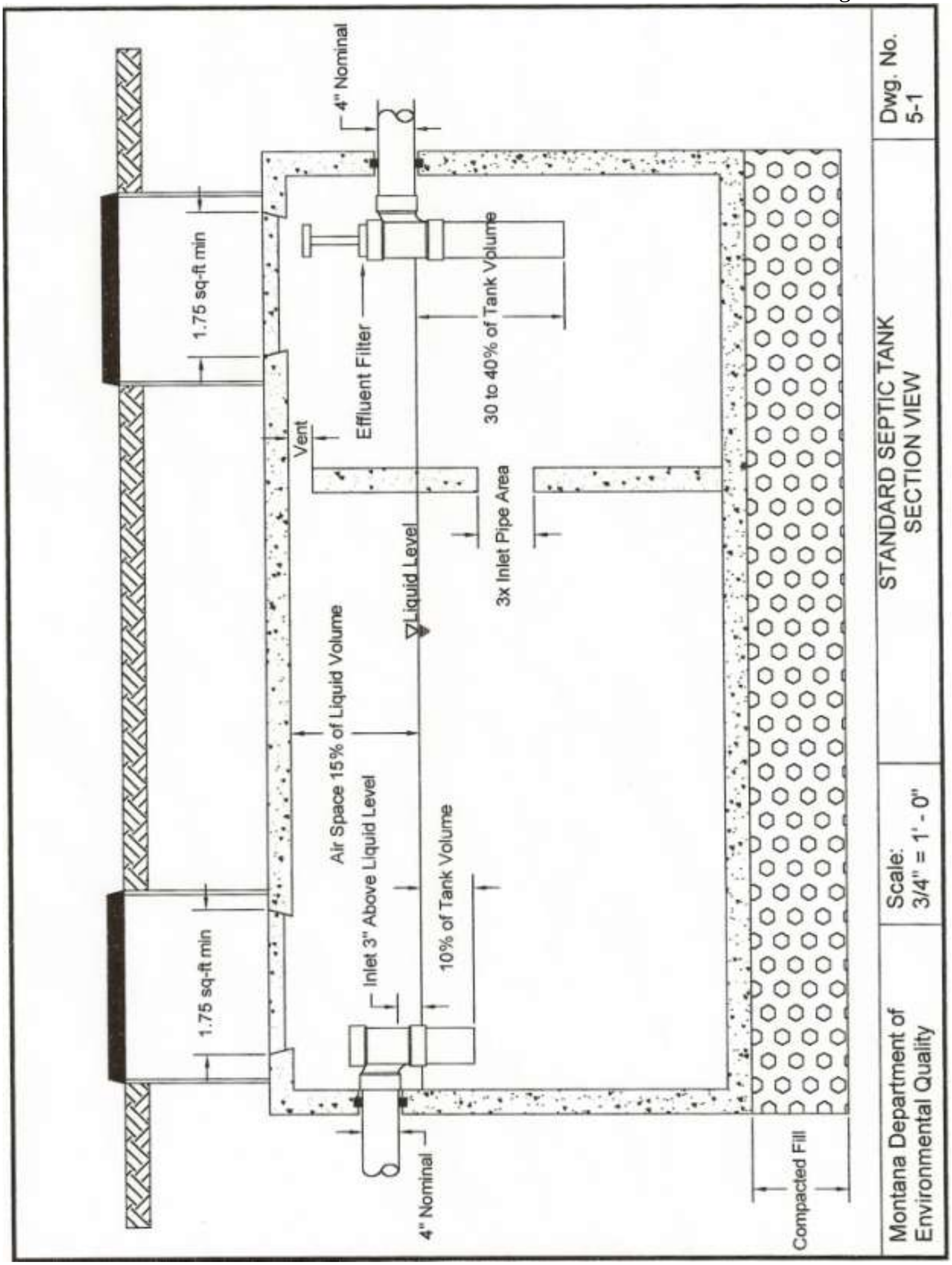
~~7.5.2 Water testing must be conducted by sealing the outlets, filling the septic tank to its operational level, and allowing the tank to stand for at least 8 hours. If there is a measurable loss (2 inches or more), refill the tank and let stand for another 8 hours. If there is again a measurable loss, the tank must be rejected.~~

~~7.5.3 Vacuum testing must be conducted by sealing all inlets, outlets, and accesses, then introducing a vacuum of 4 inches of mercury. If the vacuum drops in the first 5 minutes, it must be brought back to 4 inches of mercury. If the septic tank fails to hold the vacuum at 4 inches of mercury for 5 minutes, the tank must be rejected.~~

~~7.5.4 For pressure testing a fiberglass tank, all inlets, outlets, and access ports must be sealed and adequately secured. The tank must be charged with 5 psig (3 psig for a 12-foot diameter tank). Allow tank pressure to stabilize. Disconnect the air supply. If there is any noticeable pressure drop in 1 hour, the tank must be rejected or repaired. Repeat the test after repair. Release air carefully through an appropriate valve mechanism.~~

5.1.9 Maintenance

Owners of septic systems should obtain septic tanks maintenance recommendations published by Montana State University Extension Service, which are available through Montana County Extension Service offices located in each county. Two of these publications are Septic Tank and Drainfield Operation and Maintenance and Septic System Inspection and Troubleshooting. Those who own ~~the~~ systems with ~~siphons,~~ pumps~~,~~ or controls should carefully adhere to manufacturer's recommendations for operation and maintenance and seek guidance from the county extension service or local health department.


1.75 sq-ft min
1.75 sq-ft min
4" Nominal
4" Nominal
Effluent Filter
30 to 40% of Tank Volume
Vent
3x Inlet Pipe Area
Liquid Level
Air Space 15% of Liquid Volume
Inlet 3" Above Liquid Level
10% of Tank Volume
Compacted Fill
Montana Department of
Environmental Quality
Scale:
3/4" = 1' - 0"
STANDARD SEPTIC TANK
SECTION VIEW
Dwg. No.
5-1

6. SOIL ABSORPTION SYSTEMS

6.1 STANDARD ABSORPTION TRENCHES

6.1.1 General

The satisfactory operation of the wastewater treatment system is largely dependent upon wastewater quality, proper site selection and the design and construction of absorption trenches.

All new and replacement ~~drainfields~~ absorption systems must be designed to accept and treat residential strength waste. High strength waste or water treatment waste residuals must comply with Chapters 3.3. ~~that receive wastewater discharged from water treatment devices including water softeners, iron filters and reverse osmosis units must be designed to adequately dispose of the additional flow. The sizing of absorption systems is addressed in Section 8.4.2. Discharge of wastewater from water softeners into absorption trenches in clay soils with shrink/swell properties could result in premature system failure. Area-specific information on potential adverse impacts should be obtained from local health officials before connecting water softener backwash lines to on-site wastewater treatment systems with absorption trenches in clay soils with shrink/swell properties.~~

6.1.2 Location

Absorption trenches must meet the location criteria in ARM Title 17, 36, subchapter 3 or 9.

All absorption trenches must meet the site requirements of Chapter 2.

6.1.3 Trench Design

6.1.3.1 The minimum area in any absorption trench system must be based upon the flow as determined in Chapter 3 ~~5~~ and sized by the soil type and percolation rate if percolation testing is required by the reviewing authority, whichever results in a larger absorption system, in accordance with Table 2.1-1, Appendix B, and Section 6.1.4. ~~9-1 and 9-2~~. The reviewing authority may require a percolation test when the soils are variable or other conditions create the need to verify trench sizing.

6.1.3.2 An area that can be used as a replacement area for the original absorption trench system must be designated. Interim use of the area must be compatible with future absorption system use. The replacement area should ~~must~~ be located separately from the primary area and must not be interlaced within the primary area. ~~If interlaced, minimum separation must be 14 feet between primary lines.~~

6.1.3.3 Gravity-fed and gravity-dosed absorption trenches must be separated by at least 5 feet between trench walls. Pressure dosed absorption trenches must be separated by at least 4 feet between trench walls.

6.1.3.4 Gravity-fed and gravity-dosed absorption trenches must be at least 18 inches wide. Systems utilizing pressure distribution may have absorption trenches 36 inches wide. For the purposes of sizing, gravity-fed and gravity-dosed trenches ~~must~~ may not be considered more than 24 inches wide.

6.1.3.5 The bottom of the absorption trenches must be at least ~~12~~ 24 inches and no more than 36 inches below the natural ground surface. There must be a minimum of 12 inches of soil or fill material above the drain rock. ~~When the trench is less than 24 inches below ground, a cap above the natural ground surface is required. The cap must be tapered from the edge of the outermost trench wall with a 3 horizontal to 1 vertical or flatter slope. The cap must be sloped to provide positive drainage away from the center of the absorption system.~~

6.1.3.6 Gravity-fed absorption trenches may not exceed 100 feet in length from where effluent is first applied to the soil. Gravity-fed absorption trenches may be connected through a manifold to accommodate serial configurations.

~~Gravity-fed absorption field distribution lines must be 4 inches in diameter.~~

6.1.4 ~~Application rates for~~ Sizing of the absorption system

6.1.4.1 Application rates and absorption system length used for sizing onsite wastewater absorption systems can be determined ~~by~~ using soil descriptions in accordance with Table 2.1-1, Appendix B ~~8-1 for residential systems and Table 8-2 for nonresidential facilities with~~ and the formula in Section 6.1.4.2 ~~8.4.2.~~ Comparison of the soil profile descriptions (at or near the depth of the infiltrative surface), percolation rate (if conducted), and USDA soils report must be used to select the most conservative application rate. ~~The residential tables have been calculated for a three bedroom residence, for more or less bedrooms (use the formula in Section 8.4.2). The commercial tables have been calculated for 100 gallons per day (gpd) flow rate, for flows other than 100 gpd, use the formula in Section 8.4.2. Comparison of the soil profile report, percolation rate, and USDA soils report will be used to select the applicable square footage for an absorption system. The application rate (gpd/ft²) is the maximum application rate for each soil type listed in Table 8-1 and Table 8-2.~~

6.1.4.2 ~~For determining~~ Absorption system sizing must be determined using the following formula: ~~, the following formula may must be used:~~

The total square feet of the absorption system area is determined using the design wastewater flow rates from Chapter 3 ~~5~~ (gpd) divided by the application rate in Table 2.1-1 8~~-1 or Table 8-2~~ (gpd/ ft²) ~~= Absorption system length area (ft²)~~ or expressed as a mathematical formula:

gpd (design wastewater flow rate) = ft^2 (total absorption area)
gpd/ft^2 (application rate)

Total trench length is calculated by dividing the total square feet of the absorption system area by the trench width or expressed as a mathematical formula:

ft^2 (total absorption area) = ft (length of trench)
ft (trench width)

6.1.4.3 Systems that provide documentation or demonstrate through a third independent party that the unit is able to meet the testing criteria and performance requirements for NSF Standard No. 40 for Class 1 certification or meet the testing requirements outlined in ARM 17.30.718 for 30 mg/L BOD and 30 mg/L TSS, testing for other continuants is not required, may utilize a reduced absorption area in accordance with the following criteria:

A. For subsurface absorption systems constructed in soils with percolation rates between 3 and 50 ~~60~~ minutes per inch as described in Chapter 2 and Appendix B, the final absorption are may be reduced by 50%;

B. For subsurface absorption systems constructed in soils with percolation rates between 51 and 120 minutes per inch as described in Chapter 2 and Appendix B, the final absorption area may be reduced by 25%.

A full sized separate subsurface absorption replacement area, sized without reductions, must be designated for each site;

Further reductions in subsurface absorption system sizing beyond those listed in Section 6.1.4.3 A or B are not permissible.

~~TABLE 8-1 (Residential)~~

~~Texture~~	~~Square feet for three bedroom (ft2)~~	~~Estimated Perc rate (min/in)~~	~~Application rate (gpd/ft2)~~
~~Gravelly sand or very coarse sands (a)~~	~~375~~	~~< 3 (a)~~	~~0.8(a)~~
~~Loamy sand, coarse sand~~	~~375~~	~~3 – < 6~~	~~0.8~~
~~Medium sand, sandy loam~~	~~500~~	~~6 – <10~~	~~0.6~~
~~Fine sandy loam, loam, silt loam~~	~~600~~	~~10 – <16~~	~~0.5~~
~~Very fine sand, sandy clay loam~~	~~750~~	~~16 – <31~~	~~0.4~~
~~Clay loam, silty clay loam~~	~~1000~~	~~31 – <51~~	~~0.3~~
~~Sandy clay, clay, or silty clay~~	~~1500(b)(c)~~	~~51 – <121~~	~~0.2~~
~~Clays, silts, silty clays (soil is reported~~	~~2000(d)~~	~~≥ 121~~	~~0.15~~

~~throughout the soil profile) (USE EVTA BED)~~			
~~Clays or silts, pan evaporation rates do not allow for EVTA use~~		~~≥ 121~~	~~NP~~

~~(a) If the soil for 3 feet below the infiltrative surface is gravelly sand or very coarse sands, or there is less than 6 feet separation between the bottom of the trench and a limiting layer, the trench must be pressured-dosed or other treatment provided as approved by the reviewing authority. If the soil for 3 feet below the infiltrative layer is very gravelly sand or coarser textured, the trench also must be sand-lined or other treatment as approved by the reviewing authority.~~
~~(b) Pressure distribution will be required if more than 500 lineal feet (or 1000 square feet) of distribution line is needed.~~
~~(c) Comparison of soils profile report, percolation rate, and USDA soils report will be used to select applicable square footage.~~
~~(d) Square footage is increased because the trench sidewall is not available in EVTA bed systems.~~
~~NP Not permitted~~

~~TABLE 8-2 (Nonresidential Facilities)~~

~~Texture~~	~~Square feet for 100 gpd (ft²)~~	~~Estimated Perc rate (min/in)~~	~~Application rate (gpd/ft²)~~
~~Gravelly sand or very coarse sands (a)~~	~~125~~	~~< 3 (a)~~	~~0.8 (a)~~
~~Loamy sand, coarse sand~~	~~125~~	~~3 - < 6~~	~~0.8~~
~~Medium sand, sandy loam~~	~~167~~	~~6 - <10~~	~~0.6~~
~~Fine sandy loam, loam, silt loams~~	~~200~~	~~10 - <16~~	~~0.5~~
~~Very fine sand, sandy clay loam~~	~~250~~	~~16 -<31~~	~~0.4~~
~~Clay loam, silty clay loam~~	~~333~~	~~31 - <51~~	~~0.3~~
~~Sandy clay, clay or silty clay~~	~~500(b)(c)~~	~~51 - < 121~~	~~0.2~~
~~Clays, silts, silty clays (soil is reported throughout the soil profile) (USE EVTA BED)~~	~~667 (d)~~	~~≥ 121~~	~~0.15~~
~~Clays or silts, pan evaporation rates do not allow for EVTA use~~	~~NP~~	~~≥ 121~~	~~NP~~

~~(a) If the soil for 3 feet below the infiltrative surface is gravelly sand or very coarse sands, or there is less than 6 feet separation between the bottom of the trench and a limiting layer, the trench must be pressured-dosed or other treatment provided as approved by the reviewing authority. If the soil for 3 feet below the infiltrative layer is very gravelly sand or coarser textured, the trench also must be sand-lined or other treatment as approved by the reviewing authority.~~
~~(b) Pressure distribution will be required if more than 500 lineal feet (or 1,000 square feet) of distribution line is needed.~~

~~(c) Comparison of soils profile report, percolation rate, and USDA soils report will be used to select applicable square footage.~~
~~(d) Square footage is increased because the trench sidewall is not available in EVTA bed systems.~~
~~NP Not permitted~~

~~Slope~~

~~Gravity-fed and gravity-dosed absorption field distribution lines pipes and trenches must be level. Pressure-dosed distribution lines pipes in a sand filter or absorption system must be level, unless a hydraulic analysis indicates uniform distribution of effluent will occur with a sloped line.~~

~~Material~~

~~The material used to cover the top of the drain rock must be synthetic drainage fabric or several (two to four) layers of untreated building paper. A 2-inch layer of straw may be substituted when these materials are unavailable. Nonporous plastic or treated building paper may not be used.~~

~~Distribution boxes~~

~~If a distribution box is used, it must:~~

~~A. Be set level and bedded to prevent settling.~~
~~B. Use some flow control or baffling device to ensure equal distribution of effluent.~~
~~C. Be water tested for equal distribution.~~
~~D. Have each outlet serving an equal length of absorption trench.~~
~~E. If constructed using concrete, the concrete must meet the same requirements as concrete for septic tanks in 7.2.2. Minimum wall, floor, and lid thickness for concrete distribution boxes must be 2 inches. Reinforcement is not required for concrete distribution boxes.~~
~~F. Have an access for inspection provided either through a riser or be marked with iron or a suitable, durable marker.~~

6.1.5 Construction

~~Pipes leading into and out of septic tanks must have solid walls. Schedule 40 pipe must be used leading into and out of the septic tank in the area of backfill around the tank for a minimum length of at least 10 feet. Pipes that are either 4 or 6 inches in diameter must and have a minimum downward slope of 1/8 inch per foot. Pipes greater than 6 inches in diameter must have a minimum downward slope of 1/4 inch per foot.~~

~~A manifold must be installed between the septic tank and the absorption trenches. The manifold must be of watertight construction. Distribution boxes may be used in gravity systems in lieu of manifolds. Manifolds used in gravity systems must be set level and arranged so that effluent is distributed to an equal length of distribution pipe on both sides of the junction of the inlet discharge pipe to the manifold. Distribution boxes may be used in gravity systems in lieu of manifolds.~~

~~Distribution boxes~~

~~If a distribution box is used, it must:~~

~~A. Be set level and bedded to prevent settling.~~
~~B. Use some flow control or baffling device to ensure equal distribution of effluent.~~
~~C. Be water tested for equal distribution.~~
~~D. Have each outlet serving an equal length of absorption trench.~~
~~E. If constructed using concrete, the concrete must meet the same requirements as concrete for septic tanks in 5.1.7.1.7.2.2. Minimum wall, floor, and lid thickness for concrete distribution boxes must be 2 inches. Reinforcement is not required for concrete distribution boxes.~~
~~F. Have an access for inspection provided either through a riser or be marked with iron or a suitable, durable marker.~~

6.1.5.1 Gravity-fed and gravity-dosed absorption field distribution pipes and trench bottoms must be level. Pressure-dosed distribution pipes in an absorption system or sand filter must be level, unless a hydraulic analysis indicates uniform distribution of effluent will occur with a sloped line.

6.1.5.2 When the trenches have been excavated, the sides and bottom must be raked to scarify any smeared soil surfaces. Construction equipment not needed to construct the system should be kept off the area to be utilized for the absorption trench system to prevent undesirable compaction of the soils. Construction must not be initiated when the soil moisture content is high.

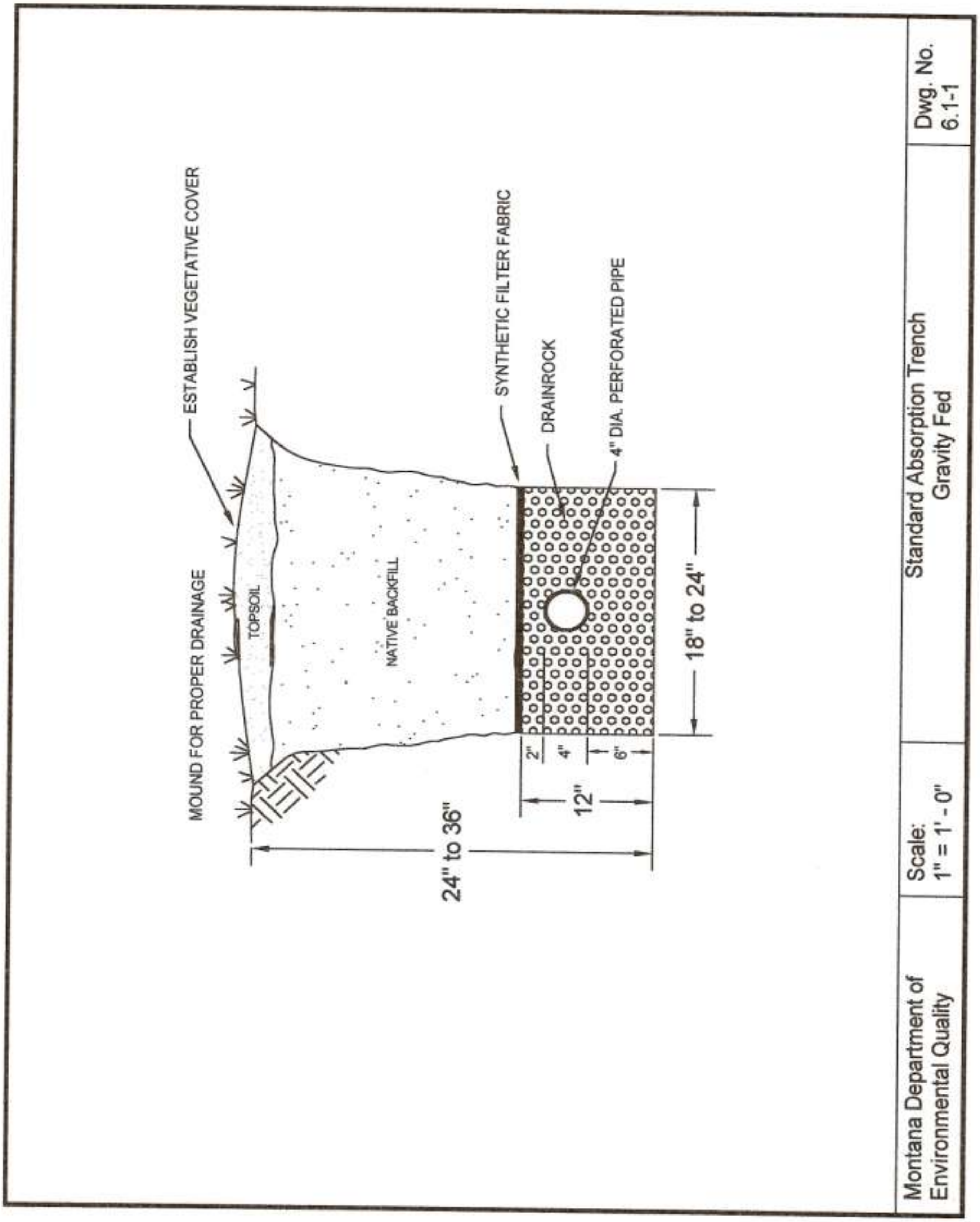
Note: If a sample of soil within the working depth can be easily rolled into the shape of a wire or ribbon ~~cast~~, the soil moisture content is too high for construction purposes.

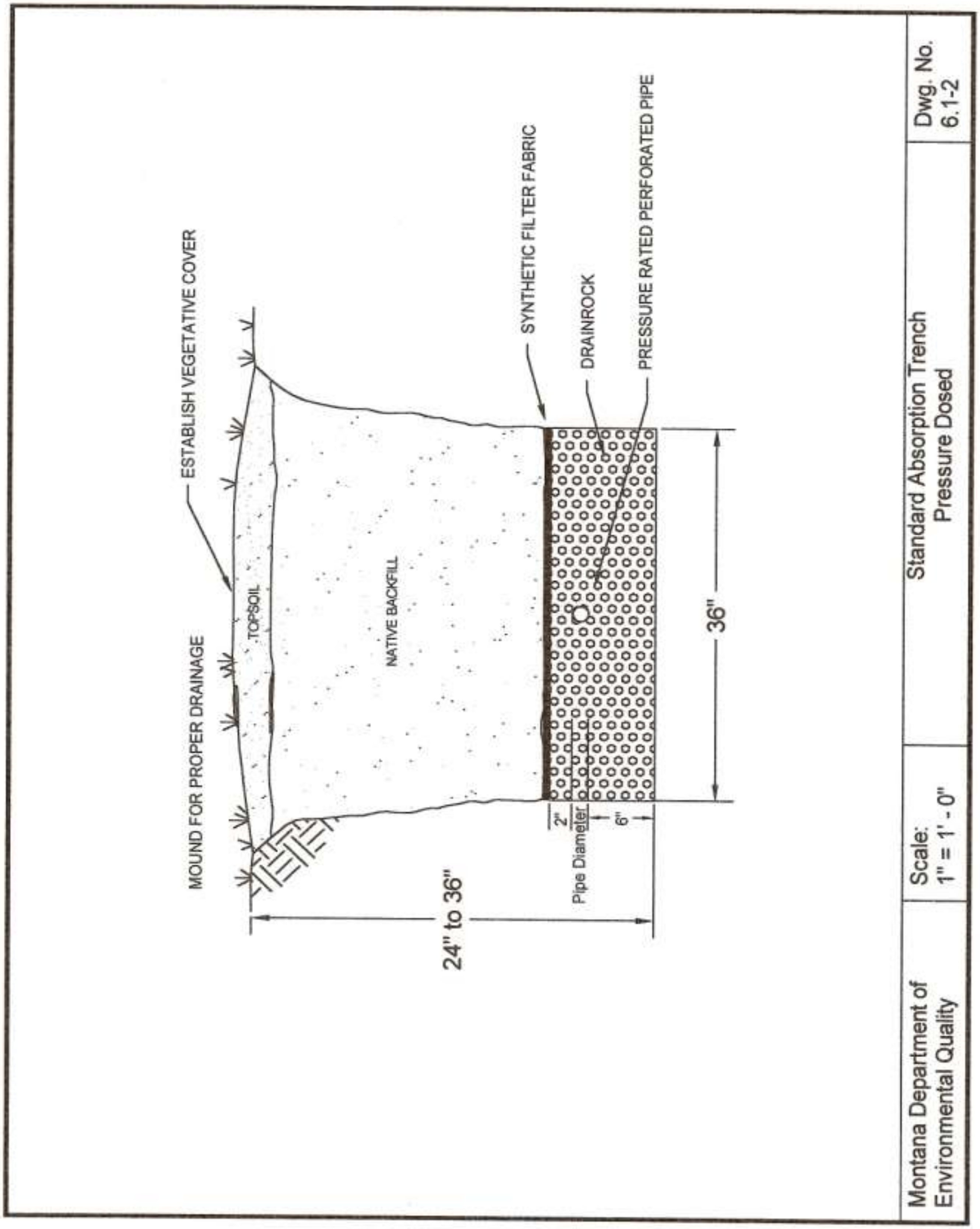
6.1.5.3 At least 6 inches of drain rock must be placed in the bottom of the trench.

6.1.5.4 The distribution pipe must be covered with at least 2 inches of drain rock. An appropriate geotextile fabric, untreated building paper, or straw must be placed over the drain rock and covered with a minimum of 12 inches of soil or fill.

6.1.5.5 The ends of the distribution pipes must be capped or plugged. ~~when they are at equal elevations, they should be connected.~~

6.1.5.6 ~~Leaching chambers~~ Gravelless trenches and other absorption systems may be used in place of distribution pipe and drain rock in accordance with Chapter 6.5 ~~13~~.


ESTABLISH VEGETATIVE COVER
MOUND FOR PROPER DRAINAGE
TOPSOIL
NATIVE BACKFILL
SYNTHETIC FILTER FABRIC
DRAINROCK
4" DIA. PERFORATED PIPE
18" to 24"
24" to 36"
12"
2"
4"
6"
Montana Department of Environmental Quality
Scale: 1" = 1' - 0"
Standard Absorption Trench Gravity Fed
Dwg. No. 6.1-1


ESTABLISH VEGETATIVE COVER
MOUND FOR PROPER DRAINAGE
TOPSOIL
NATIVE BACKFILL
SYNTHETIC FILTER FABRIC
DRAINROCK
PRESSURE RATED PERFORATED PIPE
36"
24" to 36"
2"
Pipe Diameter
6"
Montana Department of Environmental Quality
Scale: 1" = 1' - 0"
Standard Absorption Trench Pressure Dosed
Dwg. No. 6.1-2

6.2 SHALLOW CAPPED ABSORPTION TRENCHES

6.2.1 General

A shallow capped absorption trench is used to maintain a 4-foot separation between the bottom of the infiltrative surface and a limiting layer and/or to increase vertical separation distances in porous soils. Shallow capped absorption trenches must meet the same requirements as a Standard Absorption Trench, Chapter 6.1, and if applicable Gravelless and Other Absorption Systems Methods, Chapter 6.5 except where specifically modified in this chapter.

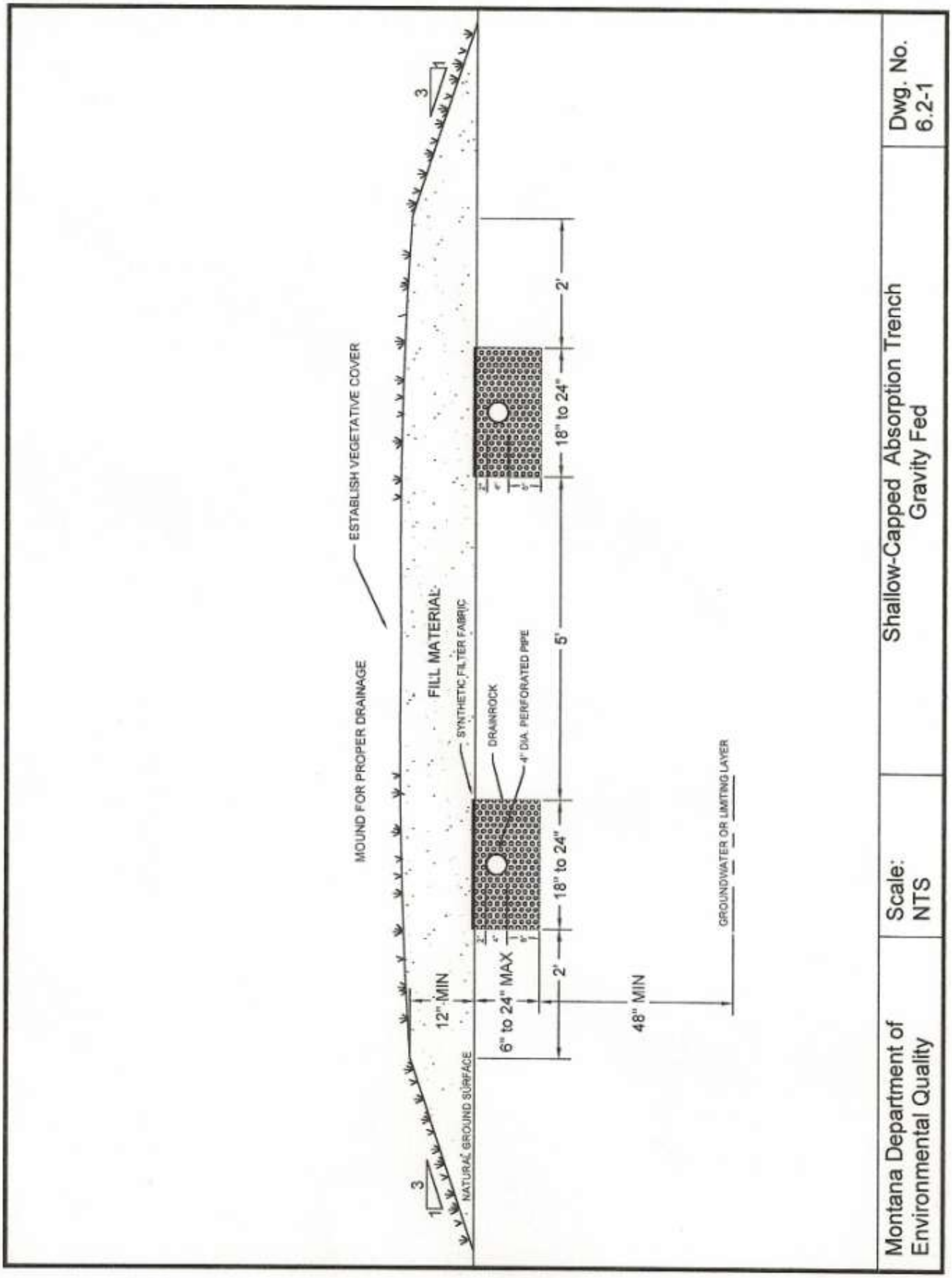
6.2.2 Design

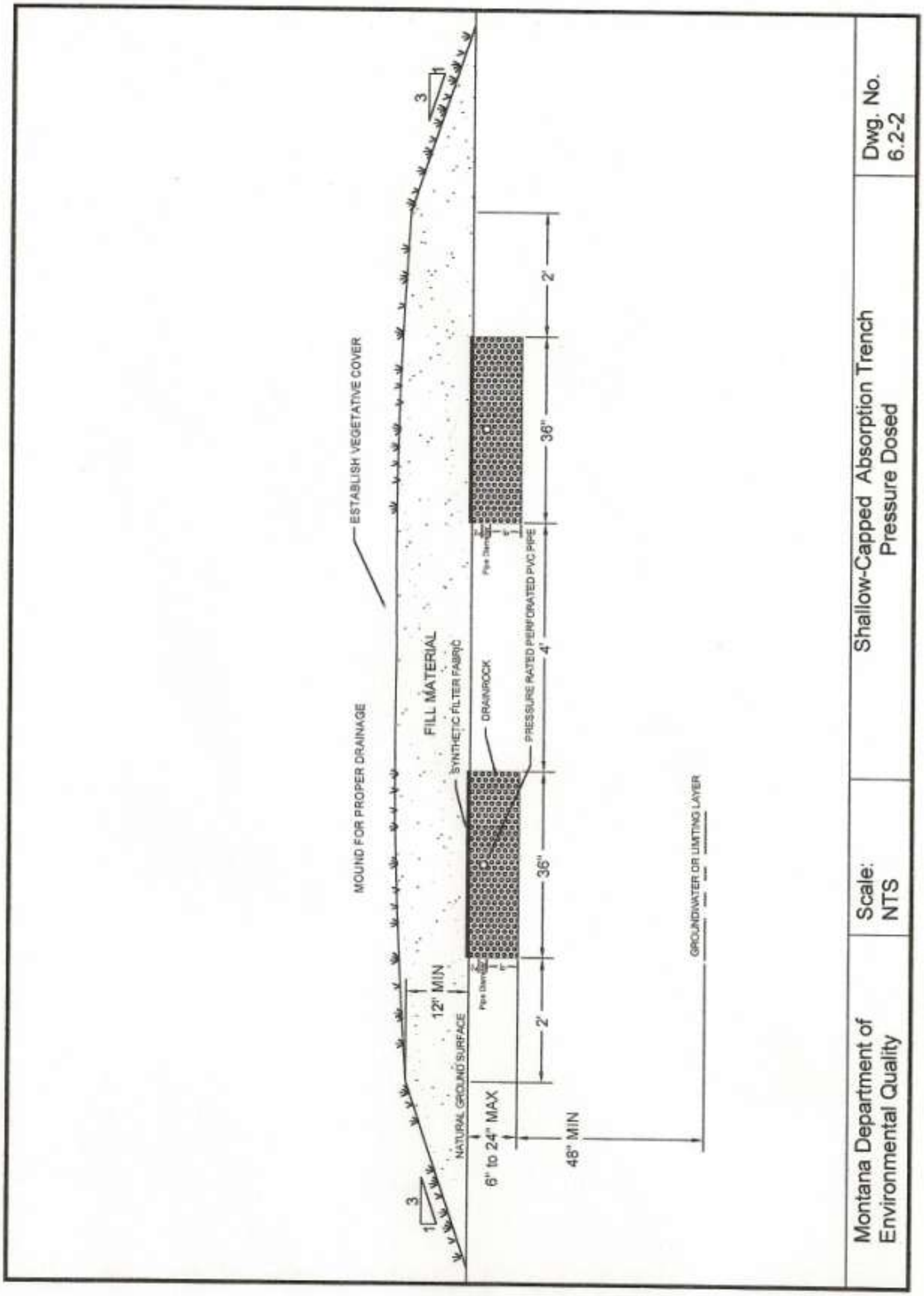
6.2.2.1 Shallow capped absorption trenches must be 6 inches to 24 inches below the natural ground.

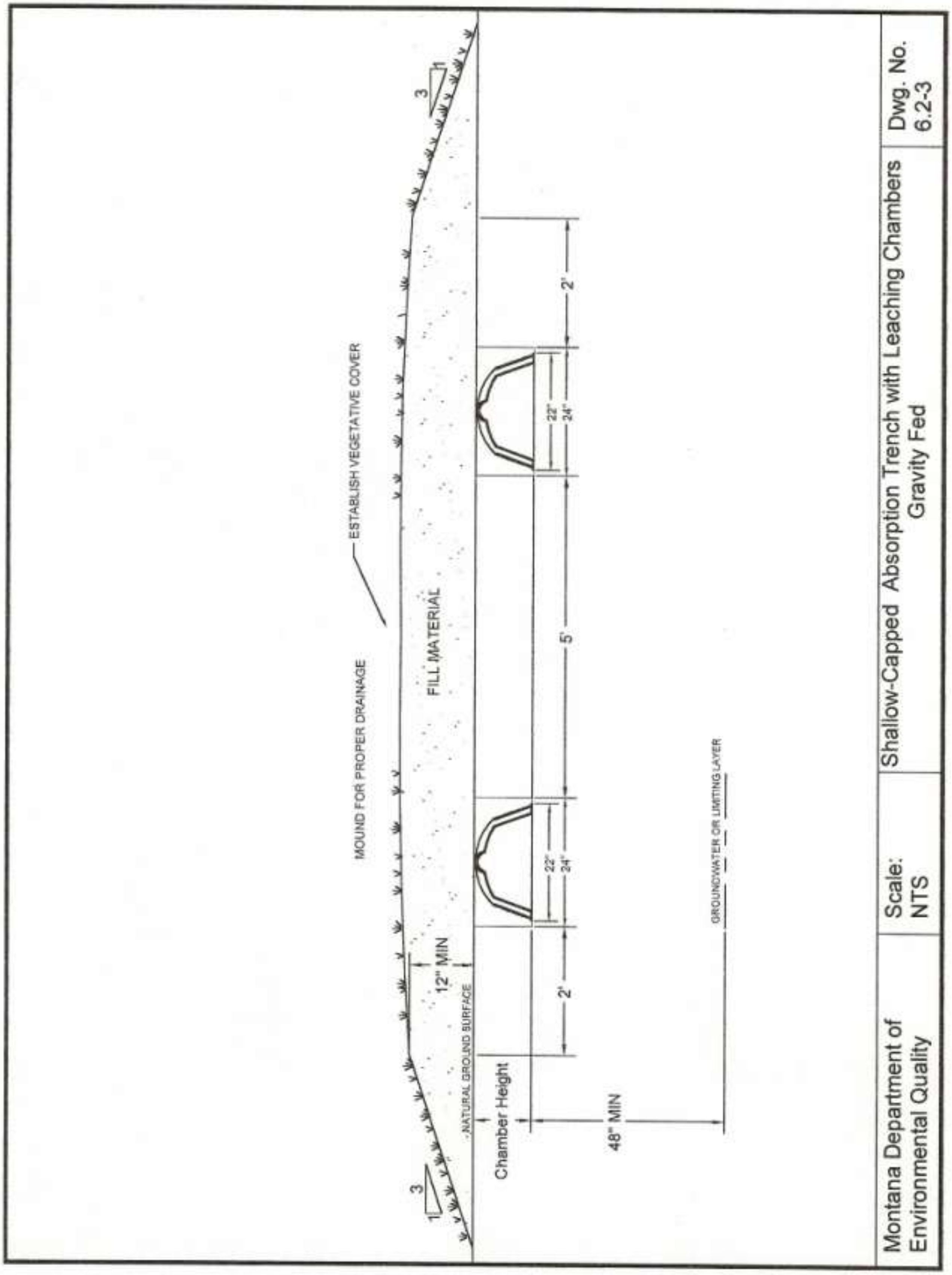
6.2.3 Construction

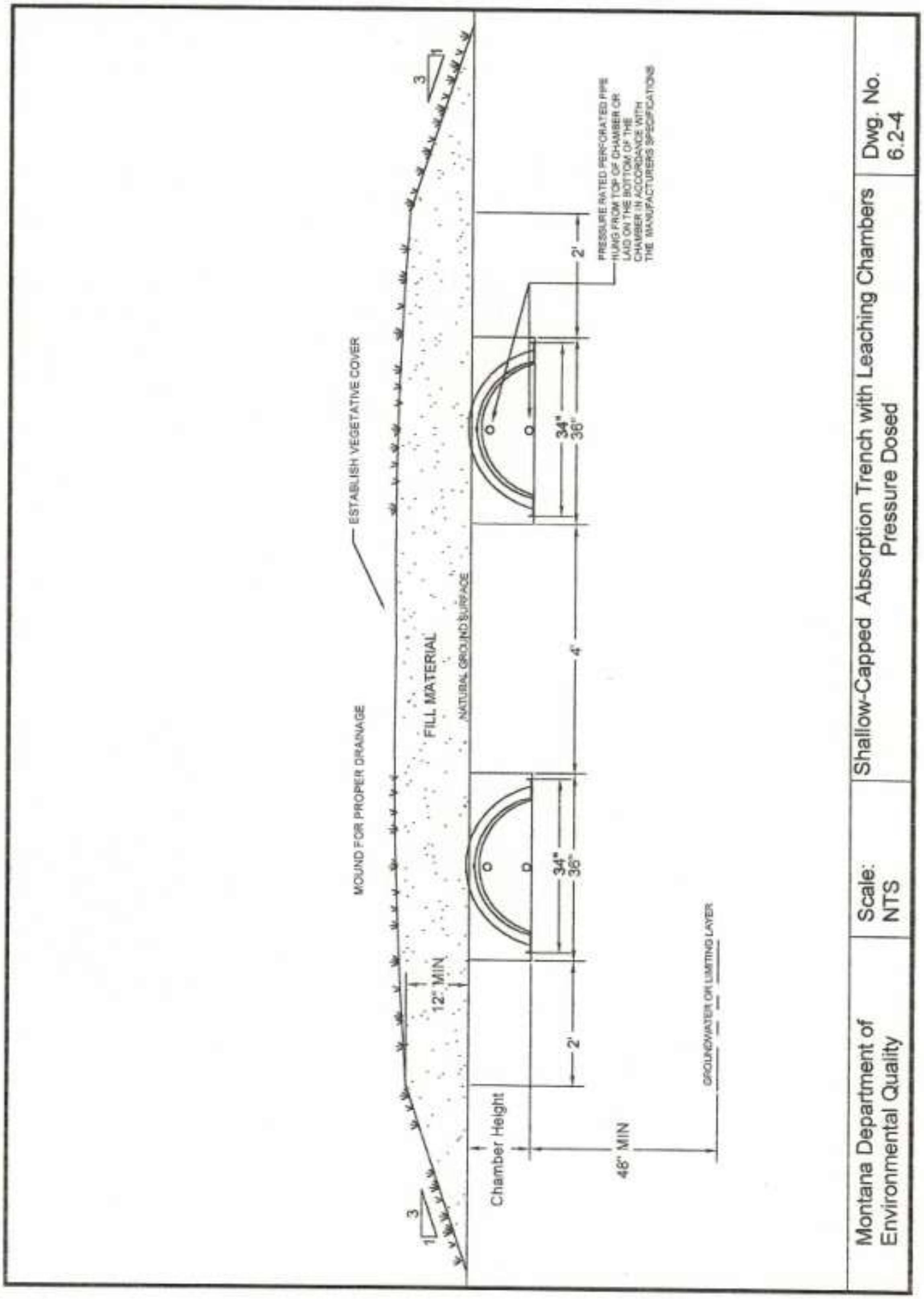
6.2.3.1 Shallow capped absorption trench systems require a cap of topsoil material a minimum of 12 inches deep. This cap must be loamy sand or sandy loam and must extend 2 feet beyond the edges of the required absorption area before the sides are shaped to a 3 horizontal to 1 vertical or lesser slope. The cap must be sloped to provide positive drainage away from the center of the absorption system. The entire mound must be seeded, sodded, or otherwise provided with shallow-rooted vegetative cover to ensure stability of the installation.

6.2.3.2 If gravelless or other absorption trenches are used, depth of bury must be in accordance with manufacturer's recommendations but the top of the chamber must be no less than the level of the natural ground.


MOUND FOR PROPER DRAINAGE
ESTABLISH VEGETATIVE COVER
FILL MATERIAL
SYNTHETIC FILTER FABRIC
DRAINROCK
4" DIA. PERFORATED PIPE
NATURAL GROUND SURFACE
GROUNDWATER OR LIMITING LAYER
3
1
12" MIN
6" to 24" MAX
48" MIN
2'
18" to 24"
5'
18" to 24"
2'
Montana Department of
Environmental Quality
Scale:
NTS
Shallow-Capped Absorption Trench
Gravity Fed
Dwg. No.
6.2-1


ESTABLISH VEGETATIVE COVER
MOUND FOR PROPER DRAINAGE
FILL MATERIAL
SYNTHETIC FILTER FABRIC
DRAINROCK
PRESSURE RATED PERFORATED PVC PIPE
NATURAL GROUND SURFACE
GROUNDWATER OR LIMITING LAYER
12" MIN
6" to 24" MAX
48" MIN
2'
36"
4'
36"
2'
3
1
3
1
Montana Department of
Environmental Quality
Scale:
NTS
Shallow-Capped Absorption Trench
Pressure Dosed
Dwg. No.
6.2-2


ESTABLISH VEGETATIVE COVER
MOUND FOR PROPER DRAINAGE
FILL MATERIAL
3
1
12" MIN
NATURAL GROUND SURFACE
Chamber Height
48" MIN
2'
22"
24"
5'
GROUNDWATER OR LIMITING LAYER
Montana Department of Environmental Quality
Scale: NTS
Shallow-Capped Absorption Trench with Leaching Chambers Gravity Fed
Dwg. No. 6.2-3


ESTABLISH VEGETATIVE COVER
MOUND FOR PROPER DRAINAGE
FILL MATERIAL
NATURAL GROUND SURFACE
3
1
12" MIN
Chamber Height
48" MIN
2'
4'
34"
36"
PRESSURE RATED PERFORATED PIPE HUNG FROM TOP OF CHAMBER OR LAID ON THE BOTTOM OF THE CHAMBER IN ACCORDANCE WITH THE MANUFACTURERS SPECIFICATIONS
GROUNDWATER OR LIMITING LAYER
Montana Department of Environmental Quality
Scale: NTS
Shallow-Capped Absorption Trench with Leaching Chambers Pressure Dosed
Dwg. No. 6.2-4

~~**AT-GRADE ABSORPTION TRENCHES**~~

~~General~~

~~At-grade systems may be used only for residential strength wastewater and where the design flow does not exceed 500 gallons per day. At-grade systems must not be installed on land with a slope greater than 6 percent or where the percolation rate is slower than 40 minutes per inch.~~

~~Effective area~~

~~The effective area is that area which is available to accept effluent. Effective length of the absorption area is the actual length of the trench, which cannot exceed the length of the pipe by more than one-half the orifice spacing. The effective width is the actual of the washed rock below the distribution pipe. s not to exceed 3 feet for each pipe.~~

~~The effective area must be 1.5 times the area required for a standard absorption trench, as described in Table 9-1. Percolation tests must be conducted at a depth of not more than 12 inches below ground surface.~~

~~Pressure distribution is required for at-grade systems.~~

~~Construction~~

~~The ground surface where the system is to be placed must be plowed scarified, or trenched less than 12 inches in depth. Trenching is preferred to plowing or scarifying to prevent horizontal migration of the effluent. There must be at least four feet of natural soil between the scarified layer and groundwater or other limiting layer. The absorption "trench" is constructed by placing drain rock on the scarified ground. with a minimum width of 24 inches at the bottom of the distribution pipe. A minimum of 6 inches of drain rock must be placed under the distribution pipe and a A minimum of 2 inches of drain rock must be placed over the distribution pipe. Leaching chambers may be used in place of distribution pipe and drain rock in accordance with Chapter 13.~~

~~An appropriate geotextile fabric must be placed over the drain rock and covered with approximately 1 foot of soil.~~

~~The fill over the distribution pipe must extend on all sides at least 5 feet beyond the edge of the aggregate below the distribution pipe.~~

~~Construction equipment which would cause undesirable compaction of the soils must not be moved across the plowedsurface, or the effluent disposal area.. Construction and/or plowing must not be initiated when the soil moisture content is high.~~

~~Note: If a sample of soil within the working depth can be easily rolled into the shape of a wire or cast, the soil moisture content is too high for construction purposes.~~

6.3 DEEP ABSORPTION TRENCHES

6.3.1 General

Deep absorption trenches are systems that have trenches excavated ~~may be used to break~~ through a less permeable soil layer to allow effluent to infiltrate into a deeper and more permeable soil. The trench is then backfilled with a sandy soil to the depth of a standard absorption trench, twenty four to thirty six inches below natural ground surface. The bottom of the deep absorption trench must not be more than 5 feet below natural ground surface. Deep absorption trenches must meet the same requirements as a standard absorption trench as described in Chapter 6.1, except where specifically modified in this chapter.

6.3.2 Location

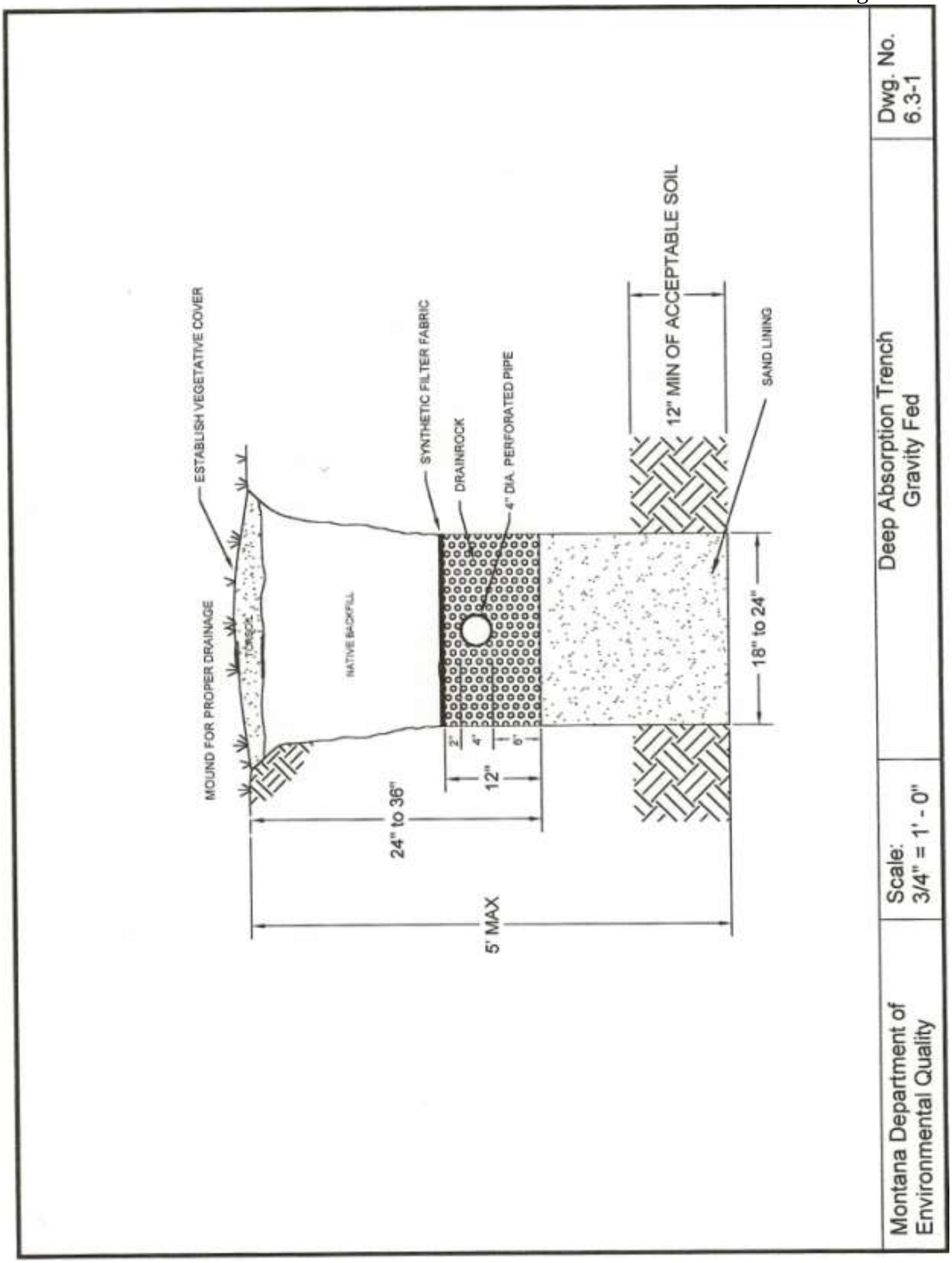
The site evaluation as outlined in Chapter 2 must also include soil profile descriptions of at least two soil observation pits excavated to a minimum depth of 4 feet below the proposed deep absorption trench bottom. ~~All separation distances in ARM Title 17, Chapter 36, subchapter 3 or 9 must be maintained. Monitoring to establish depth to seasonally high ground water may be required where the reviewing authority has reason to believe that ground water is within 6 feet of the bottom of the absorption trench.~~

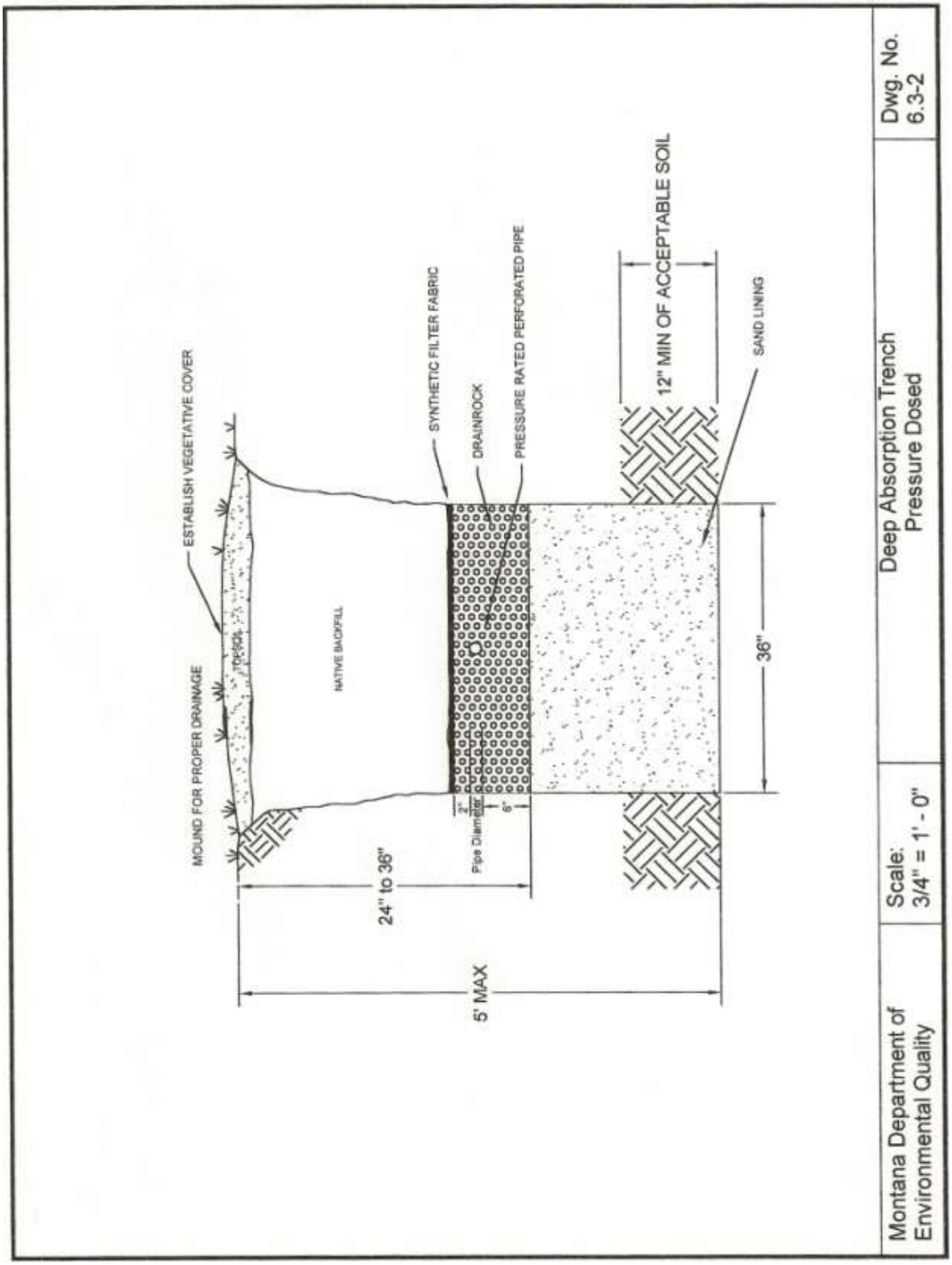
6.3.3 Construction

~~Deep absorption trenches must be constructed at least 1 foot into suitable soil.~~ The deep trench must be ~~dug~~ excavated 1 foot into the acceptable soil and backfilled with medium sand (with no more than 3 percent finer than the No. 100 sieve), ~~drain rock,~~ or other approved material to the level of a standard absorption trench. The system must be sized based on the most conservative application rate when comparing the deep trench infiltrative surface or the backfill sand.

6.3.4 ~~The bottom (invert) of the distribution pipe for a deep absorption trench must be installed no deeper than 30 inches from the ground surface. The deep trench must be dug 1 foot into the acceptable soil and backfilled with a medium sand (with no more than 3 percent finer than the No. 100 sieve), drain rock, or other approved material to the level of a standard absorption trench. The system must be sized based on the lesser application rate for the soil infiltrative surface or the backfill sand.~~

6.3.5 ~~Leaching chambers may be used in place of distribution pipe and drain rock in accordance with Chapter 13.~~


ESTABLISH VEGETATIVE COVER
MOUND FOR PROPER DRAINAGE
TOPSOIL
NATIVE BACKFILL
SYNTHETIC FILTER FABRIC
DRAINROCK
4" DIA. PERFORATED PIPE
12" MIN OF ACCEPTABLE SOIL
SAND LINING
24" to 36"
5' MAX
12"
2"
4"
6"
18" to 24"
Deep Absorption Trench
Gravity Fed
Dwg. No.
6.3-1
Scale:
3/4" = 1' - 0"
Montana Department of
Environmental Quality


MOUND FOR PROPER DRAINAGE
ESTABLISH VEGETATIVE COVER
TOPSOIL
NATIVE BACKFILL
SYNTHETIC FILTER FABRIC
DRAINROCK
PRESSURE RATED PERFORATED PIPE
12" MIN OF ACCEPTABLE SOIL
SAND LINING
36"
2"
Pipe Diameter
6"
24" to 36"
5' MAX
Montana Department of
Environmental Quality
Scale:
3/4" = 1' - 0"
Deep Absorption Trench
Pressure Dosed
Dwg. No.
6.3-2

6.4 SAND-LINED ABSORPTION TRENCHES

6.4.1 General

Sand-lined absorption trenches are used for rapid permeability situations. The trench below the drain rock is lined with sand to provide additional treatment. Sand-lined absorption trenches must meet the same requirements as a standard absorption trench as described in Chapter 6.1, except where specifically modified in this chapter.

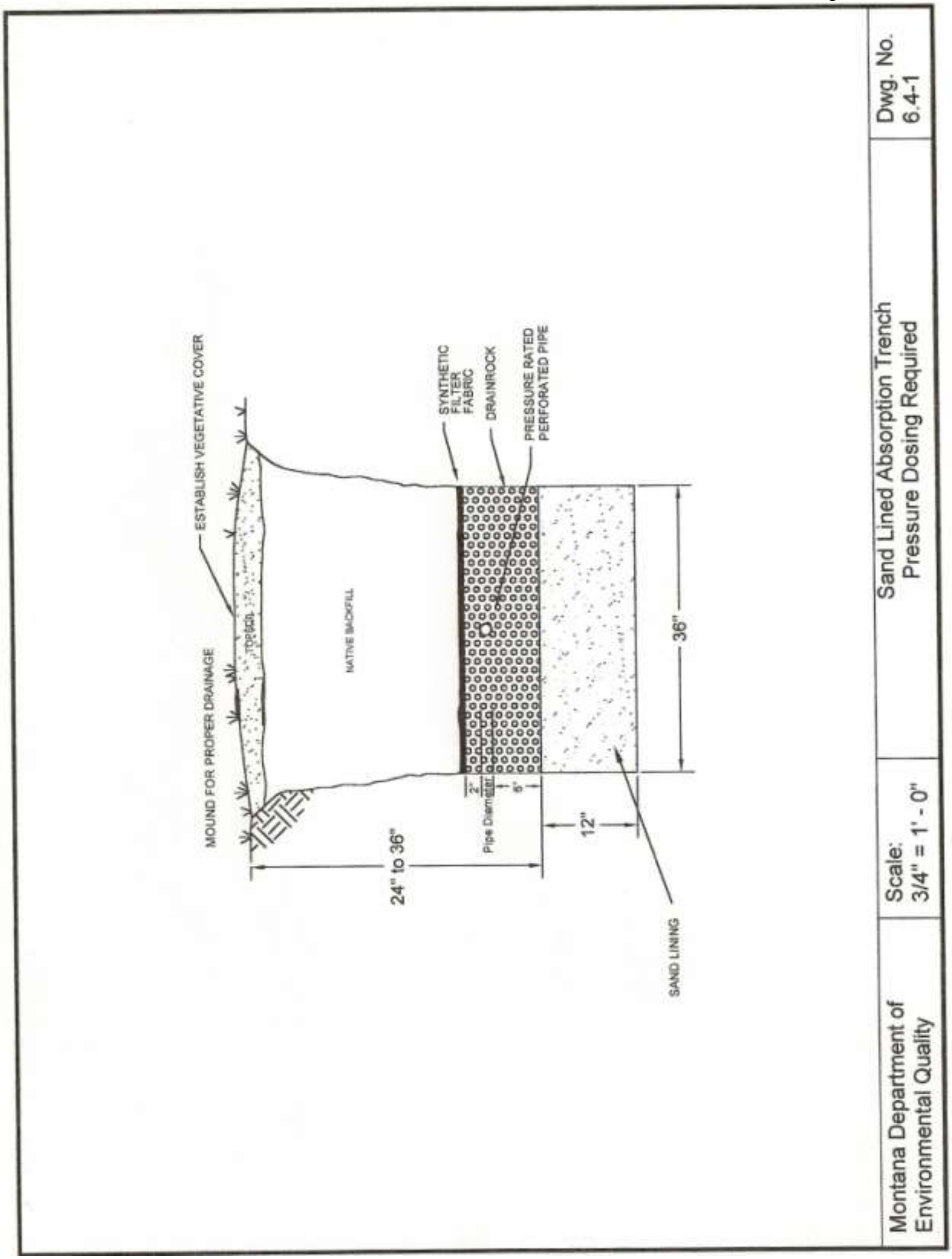
6.4.2 Design

Trenches must be lined with a minimum of 12 inches of fine to medium sand or loamy sand below the constructed absorption system. ~~For rapid permeability situations,~~ The system is to be sized in accordance with Chapter ~~8~~ 2. and Section 6.1.4 using the most conservative application rate when comparing the natural soils and the sand used for lining the trench.

Uniform pressure distribution designed in accordance with Chapter 4.3 must be provided for all sand-lined absorption trenches.

.~~for soils with percolation rates faster than 3 minutes per inch. For slow permeability situations, the system is to be sized according to the percolation rate of the soils below the trench in accordance with Chapter 8. Where systems are placed in soils with a percolation rate faster than 3 minutes per inch and the underlying soil is gravelly sand or very coarse sands, or the depth to a limiting layer is less than 6 feet from the bottom of the trench,~~ he ~~system must be designed using pressure distribution. or other treatment provided as approved by the reviewing authority. If pressure distribution is not used, the side walls of the trench must also be sand-lined a minimum of 6 inches to a point 2 inches above the pipe. As an alternative to placing sand on the side walls of the trench, a 24-inch wide trench with gravity distribution may be constructed with the sand placed such that the elevation of the sand at the center of the trench is at least 6 inches lower than the sand at the edge of the trench (i.e., form a V-ditch with the sand). The sand at the center of the trench must still be at least 12 inches in depth.~~
~~Construction~~
~~Where the side walls of the trench must be sand-lined, the trenches must be a minimum of 36 inches wide. Detailed construction specifications will be required showing how side walls will be lined. Sand must not be allowed to enter into the washed gravel zone during construction.~~

6.4.3 ~~Leaching chambers may be used in place of distribution pipe and drain rock in accordance with Chapter 13.~~


MOUND FOR PROPER DRAINAGE
ESTABLISH VEGETATIVE COVER
TOPSOIL
NATIVE BACKFILL
SYNTHETIC FILTER FABRIC
DRAINROCK
PRESSURE RATED PERFORATED PIPE
36"
12"
24" to 36"
Pipe Diameter
2"
6"
SAND LINING
Montana Department of Environmental Quality
Scale: 3/4" = 1' - 0"
Sand Lined Absorption Trench
Pressure Dosing Required
Dwg. No. 6.4-1

6.5 GRAVELLESS TRENCHES AND OTHER ABSORPTION METHODS

6.5.1 General

Gravelless trenches and other absorption systems ~~systems~~ include infiltration or leaching chambers and other wastewater distribution systems (single and multiple pipes, gravel substitutes, geo-composites, etc.). The purpose of these gravelless systems is to meet or exceed the characteristics, function and performance of gravel in conventional gravel-filled absorption systems. ~~Absorption trenches for these~~ Gravelless trenches and other absorption systems ~~systems~~ must meet the same requirements as a standard absorption trench~~es~~ as described in Chapter 6.1, except where specifically modified in this chapter.

Gravelless trenches and other absorption systems may be used in lieu of pipe and drain rock for standard absorption trenches, deep absorption trenches, ~~at-grade absorption trenches,~~ sand-lined absorption trenches, intermittent sand filters, recirculating sand filters, evapotranspiration systems, ~~and~~ evapotranspiration absorption systems, sand mounds, and absorption beds.

Pressure dosed gravelless or other absorption trench systems must meet the design requirements of Chapter 4.3.

Gravelless or other absorption systems must be installed according to the manufacturer's requirements and specifications.

6.5.2 Leaching chambers

6.5.2.1 Distribution materials

A. Leaching chambers are chambers with an open bottom structurally designed to carry the earth loading.

B. Leaching chambers must ~~consist~~ be constructed of high-density polyolefin or other approved material and must comply with IAPMO PS 63. ~~be structurally sound for their intended use. Products must maintain at least 90 percent of their original height (vertical deflection shall not exceed 10 percent of original product height) when installed according to manufacturer's installation guidelines and subjected to a 4,000-pound axle load. Vertical deflection is the combined product height deflection due to installation (soil dead load) and the 4,000-pound axle load measured when the tire is directly over the product.~~

6.5.2.2 Design

The maximum trench width for leaching chambers is 36 inches. Uniform pressure distribution designed in accordance with Chapter 4.3 must be provided for all trenches greater than 24 inches wide. ~~If the trench width exceeds 24 inches, pressure distribution will be require~~

6.5.2.3 Construction

The total bottom area of the c~~hamber~~ trench will be used to calculate the infiltration area. The absorption system size in square footage as described in ~~Chapter~~ Section 6.1.4 ~~8~~ may be reduced in size by 25 percent when using infiltration or leaching chambers. ~~Chambers that are 15 inches in width will be equal to an 18-inch trench width, a 22-inch width chamber will be equal to a 24-inch trench width, and 34-inch width chambers will be equal to a 36-inch width trench for calculating absorption system sizing~~. The size of the replacement absorption system must be large enough to accommodate a standard absorption system. ~~even though this full area will not be used as part of the primary system.~~

~~Chambers may be used in lieu of pipe and drain rock for standard absorption trenches, deep absorption trenches, at-grade absorption trenches, sand-lined absorption trenches, intermittent sand filters, recirculating sand filters, evapotranspiration systems, and evapotranspiration absorption systems, sand mounds, and absorption beds.~~

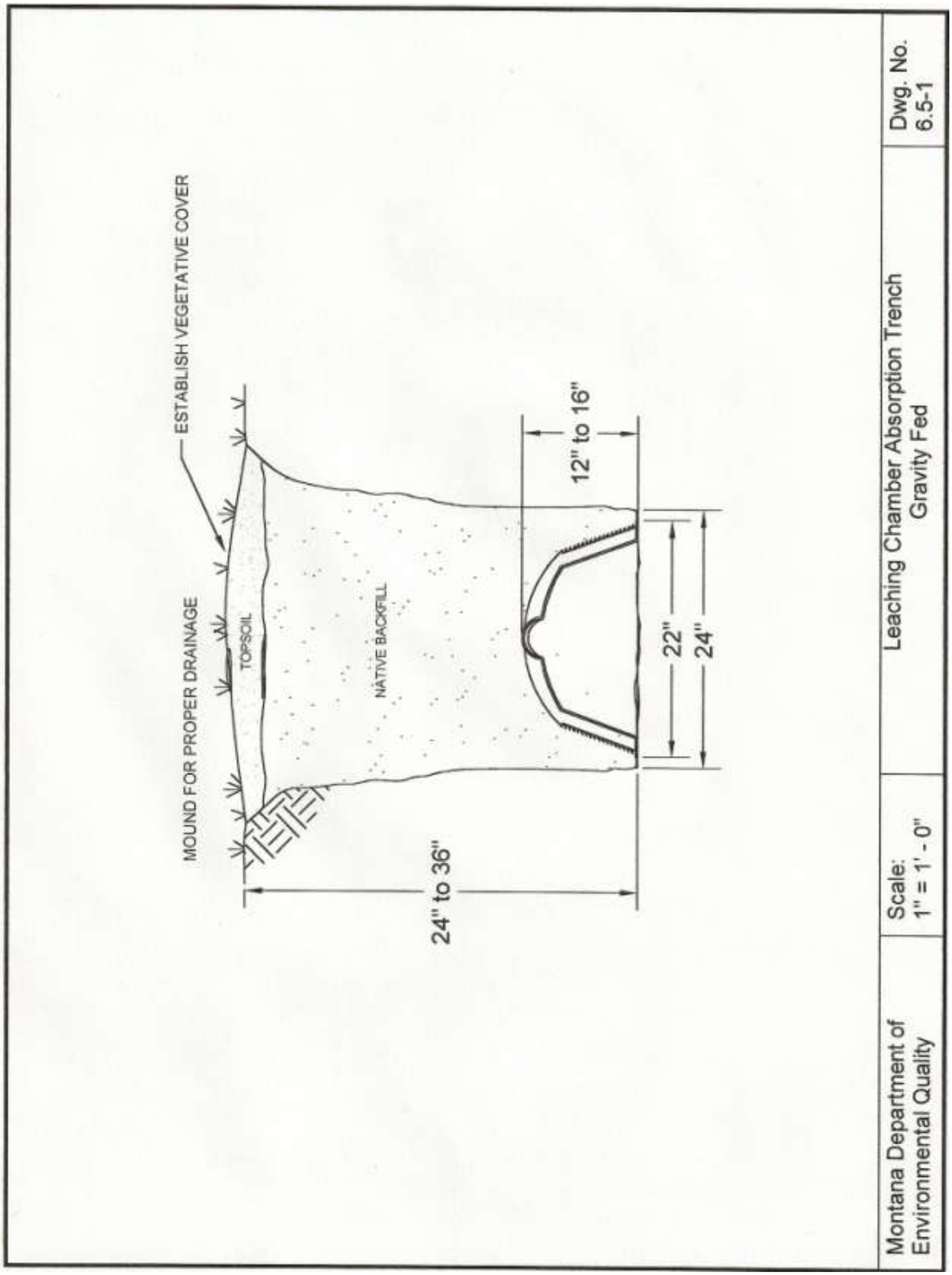
6.5.3 Other absorption systems

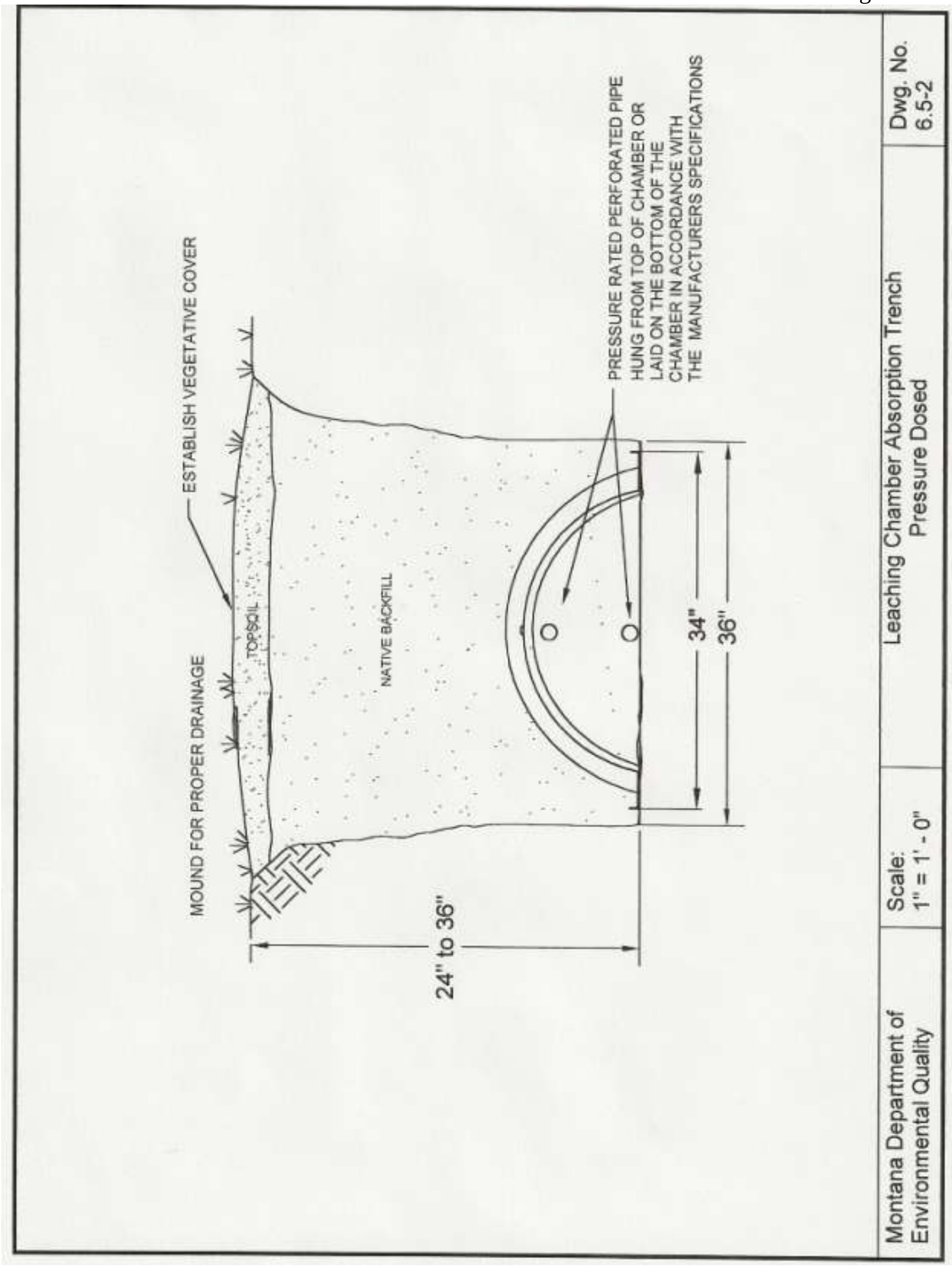
6.5.3.1 Other absorption systems must be able to meet or exceed the typical pore space of gravel in a standard absorption system with documentation presented by a third independent party.

6.5.3.2 Other absorption systems must be able to handle the pertinent depth of burial.

6.5.3.3 All other absorption systems must be installed in accordance with manufacturer's recommendations although specific proprietary designs which conflict with requirements of this circular will require reviewing authority review prior to approval.

6.5.3.4 Approval for a reduction in the other absorption system sizing may be allowed on a case-by-case basis as supported by documentation and justification submitted by the manufacturer to the reviewing authority for review.


ESTABLISH VEGETATIVE COVER
MOUND FOR PROPER DRAINAGE
TOPSOIL
NATIVE BACKFILL
12" to 16"
22"
24"
24" to 36"
Montana Department of Environmental Quality
Scale: 1" = 1' - 0"
Leaching Chamber Absorption Trench
Gravity Fed
Dwg. No. 6.5-1


MOUND FOR PROPER DRAINAGE
ESTABLISH VEGETATIVE COVER
TOPSOIL
NATIVE BACKFILL
PRESSURE RATED PERFORATED PIPE HUNG FROM TOP OF CHAMBER OR LAID ON THE BOTTOM OF THE CHAMBER IN ACCORDANCE WITH THE MANUFACTURERS SPECIFICATIONS
24" to 36"
34"
36"
Montana Department of Environmental Quality
Scale: 1" = 1' - 0"
Leaching Chamber Absorption Trench Pressure Dosed
Dwg. No. 6.5-2

6.6 ELEVATED SAND MOUNDS

6.6.1 General

Elevated sand mounds are used to achieve separation distance between the treatment system and a limiting layer.

Uniform pressure distribution designed in accordance with Chapter 4.3 must be provided for all elevated sand mounds

If an advanced wastewater treatment system is used prior to disposal in an elevated sand mound, the elevated sand mound absorption area may be downsized by 50 percent.

Gravelless trenches and other absorption systems installed in accordance with 6.5 may be used in lieu of pipe and gravel but no reduction in sizing will be permitted for the use of this technology.

6.6.2 Location

6.6.2.1 Elevated sand mounds must meet all of the site requirements of Chapter 2.

6.6.2.2 Elevated sand mounds must meet all minimum separation distances as stated in ARM Title 17, Chapter 36, subchapter 3 or 9. Separation distances must be measured from the outside of the mound where the topsoil fill meets the natural ground surface. ~~or, if the design uses a lesser slope for landscaping purposes, where the toe of the mound would be if the 3:1 slope specified in Section 14.2.7 were used~~.

6.6.2.3 Elevated sand mounds must be constructed only upon undisturbed, naturally occurring soils.

6.6.2.4 Elevated sand mounds with a basal soil application rate of 0.4-0.8 gpd/ft2, as describe in Table 2.1-1 and Appendix B, may not be installed on land with a slope greater than 12 percent. ~~on for soils with a percolation rate faster than 30 minutes per inch nor~~

Elevated sand mounds with a basal soil application rate of 0.3-0.2 gpd/ft2, as described in Table 2.1-1 and Appendix B, may not be installed on land with a slope greater than 6 percent. ~~on soils with a percolation rate between 30 and 120 minutes per inch~~.

The land area 25 feet from the toe of the infiltrative surface on all the down gradient side of the elevated sand mound must not be disturbed.

~~Where trenches are used, the trenches must be installed with the long dimension parallel to the land contour~~.

6.6.2.5 A separate replacement area must be designated for each elevated sand mound and must be sized in accordance with this chapter.

6.6.3 Design

6.6.3.1 *The Wisconsin Mound Soil Absorption System Siting, Design, and Construction Manual*, January 2000, is recommended as a procedural guideline in the design of elevated sand mounds. The requirements of this Circular may be different from those in this reference document, and the requirements of this Circular will govern in those cases.

6.6.3.2 The wastewater strength discharged to the mound must not exceed residential strength wastewater.

6.6.3.3 The required basal area of the mound must be based upon the method described in Section 6.1.1 at a soil depth no greater than 12 inches,

6.6.3.4 The required bottom area of the bed must be based upon flows as determined in Chapter 3 with an application rate of 0.8 gallons/day/square foot.

With the prior approval of the reviewing authority, the application rate may be increased for the use of finer sand than specified in this chapter.

6.6.3.5 There must be a minimum total depth of 21 inches of sand fill above the natural soil surface and 12 inches of sand fill between the bottom of the ~~trench or~~ absorption area and the natural soil surface. Sand must be washed free of silts and clays. The in-place fill material must meet one of the following specifications:

A. ASTM C-33 for fine aggregate, with a maximum of 2 percent passing the No. 100 sieve, or

B. Fit within the following particle size distribution:

Sieve	Particle Size (mm)	Percent Passing
3/8 in	9.50	100
No. 4	4.75	95 to 100
No. 8	2.36	80 to 100
No. 16	1.18	45 to 85
No. 30	0.60	20 to 60
No. 50	0.30	10 to 30
No. 100	0.15	0 to 2

C. Have an effective size (D10) of 0.15 mm to 0.30 mm with a Uniformity Coefficient (D60/D10) of 4 to 6, with a maximum of 3 percent passing the No. 100 sieve.

~~D.~~

6.6.3.6 Drain rock must be washed and range in size from ¾ to 2-1/2 inches. ~~A design engineer may specify a specific size of drain rock if evidence is provided demonstrating the specific size will function equal to the washed rock that ranges in size from ¾ to 2-1/2 inches.~~ ~~Drain rock~~ It must be at least 9 inches deep and must be covered with filter fabric.

~~14.2.4 The minimum spacing between trenches must be 4 feet, and the trench width must be 3 feet. Where beds are used, the distribution pipes must be installed parallel to the land contour, with spacing between pipes of at least 3 feet and no more than 5 feet. If using gravelless chambers, the minimum spacing must be 4 feet between the center of each chamber.~~

~~14.2.5 The required bottom area of the trench or trenches or gravel area for beds must be based upon flows and application rates as determined in Chapter 5 and Chapter 9, with an application rate of 1.0 gallons/day/square foot. A maximum flow per orifice should not create a saturated flow for the depth of the sand fill.~~

~~14.2.6 The length of the absorption trenches should be at least three times the width of the mound.~~

6.6.3.7 The distribution pipes must be installed parallel to the land contour, with spacing between pipes of at least 3 feet and no more than 5 feet. The length of a sand bed must be at least three times the width of the sand bed. Leaching chambers must be placed edge to edge. The width and length of the sand bed may need to be greater than 3 times the width to accommodate the next nearest size standard chamber.

~~For soils with percolation rates between 61 and 120 minutes per inch and with slopes of 1 to 2 percent, the land area 25 feet on all sides of the elevated sand mound must not be disturbed. A mound system that is constructed on slopes of 3 to 12 percent the effluent dispersal area is considered 50 feet on the down slope side, and the soil in this area may not be removed or disturbed except as specified. For soils with percolation rates faster than 61 minutes per inch, the land area 25 feet down slope of the elevated sand mound may not be removed or disturbed except as specified.~~

6.6.3.8 The area of sand fill must be sufficient to extend 2 feet beyond the edges of the required absorption area before the sides are shaped to a 3 horizontal to 1 vertical or lesser slope. ~~On sloping sites, the down slope setback must be based on the soil percolation rate (see 14.2.7).~~

6.6.3.9 The mound must be covered with a minimum of 12 inches ~~(~~at the center of the mound~~)~~ and 6 inches ~~(~~at the edge of the mound~~)~~ of a suitable medium, such as sandy loam, loamy sand or silt loam, to provide drainage and aeration. These depths are measured after settling.

6.6.4 Construction

6.6.4.1 The ground surface where a mound is to be placed must be plowed, ~~or~~ scarified or ~~the sand mound may be~~ keyed into the natural ground 4 inches to 8 inches parallel to the land contour. This must be achieved by removing a portion of the topsoil with the plow throwing the soil up slope to provide a proper interface between the fill and natural soils. When mounds are keyed in, the removed soil must be replaced with the same sand as required for the rest of the mound, and this sand will not count as part of the required 21 inches of sand in the mound as described in Section ~~14.2.2~~ 6.6.3.5.

6.6.4.2 Construction equipment that would cause undesirable compaction of the soils must not be moved across the plowed surface or the effluent disposal area until. ~~However, after placement of~~ a minimum of 6 inches of sand fill has been placed over the plowed area. ~~, construction equipment may be driven over the protected surface to expedite construction.~~ Construction and/or plowing must not be initiated when the soil moisture content is high.

Note: If a sample of soil within the working depth can be easily rolled into the shape of a wire or ribbon ~~cast~~, the soil moisture content is too high for construction purposes.

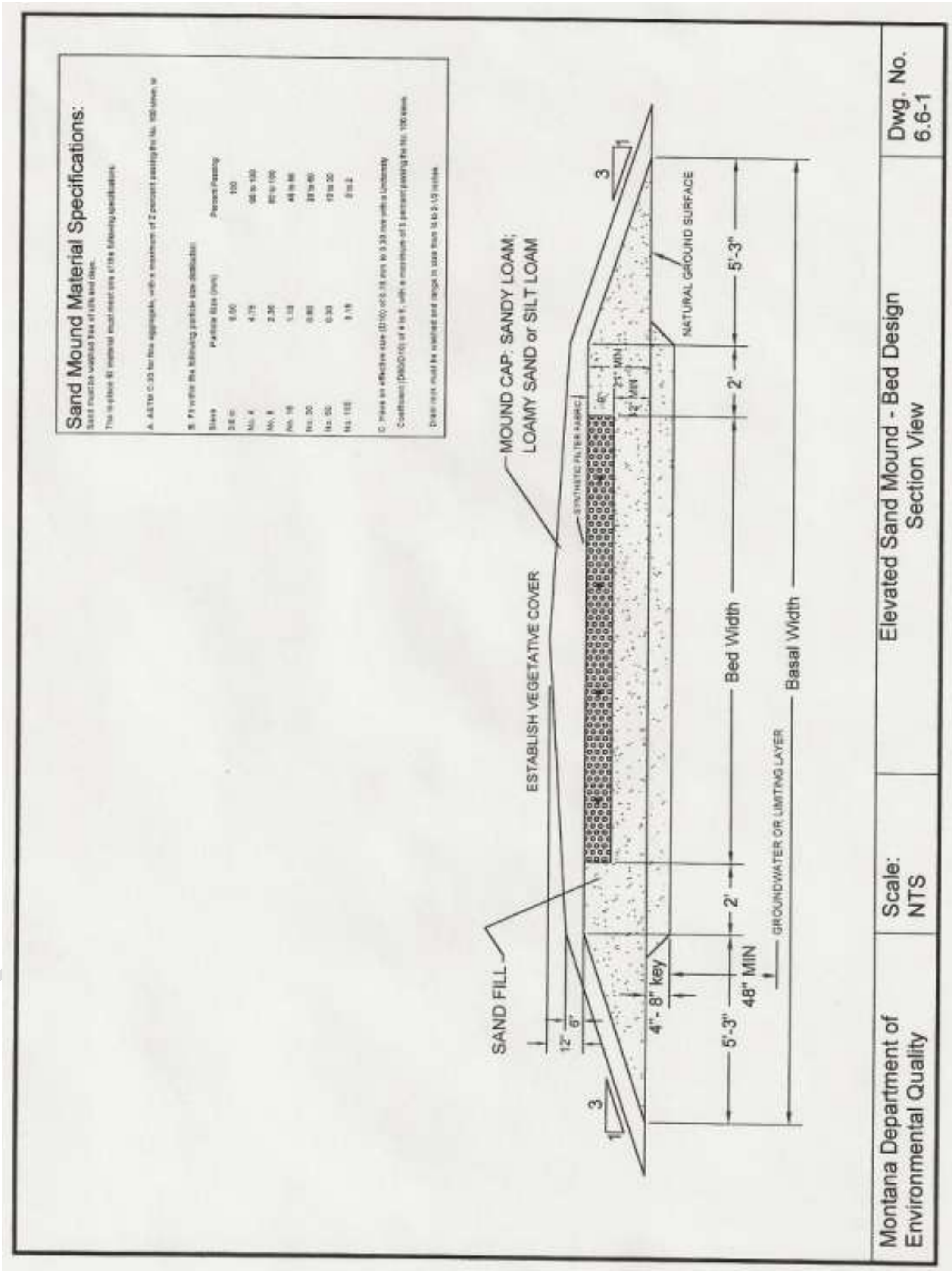
6.6.4.3 Aboveground vegetation must be closely cut and removed from the ground surface throughout the area to be utilized for the placement of the fill material. Tree stumps should be cut flush with the surface of the ground, and roots should not be pulled. Trees may be left in place within the 3:1 side sloped portion of the fill ~~The fill that is the portion of the 3 to 1 side slope may have trees left in place~~ if, in the opinion of the designer, the trees will enhance the nutrient uptake of the mound. ~~Prior to plowing or scarifying, the dosing-pump discharge line from the pump chamber to the point of connection with the distribution-piping header must be installed. The area must then be plowed, scarified, or keyed in to a depth of 4 to 8 inches, parallel to the land contour, with the plow throwing the soil up slope to provide a proper interface between the fill and natural soils. Tree stumps should be cut flush with the surface of the ground, and roots should not be pulled.~~

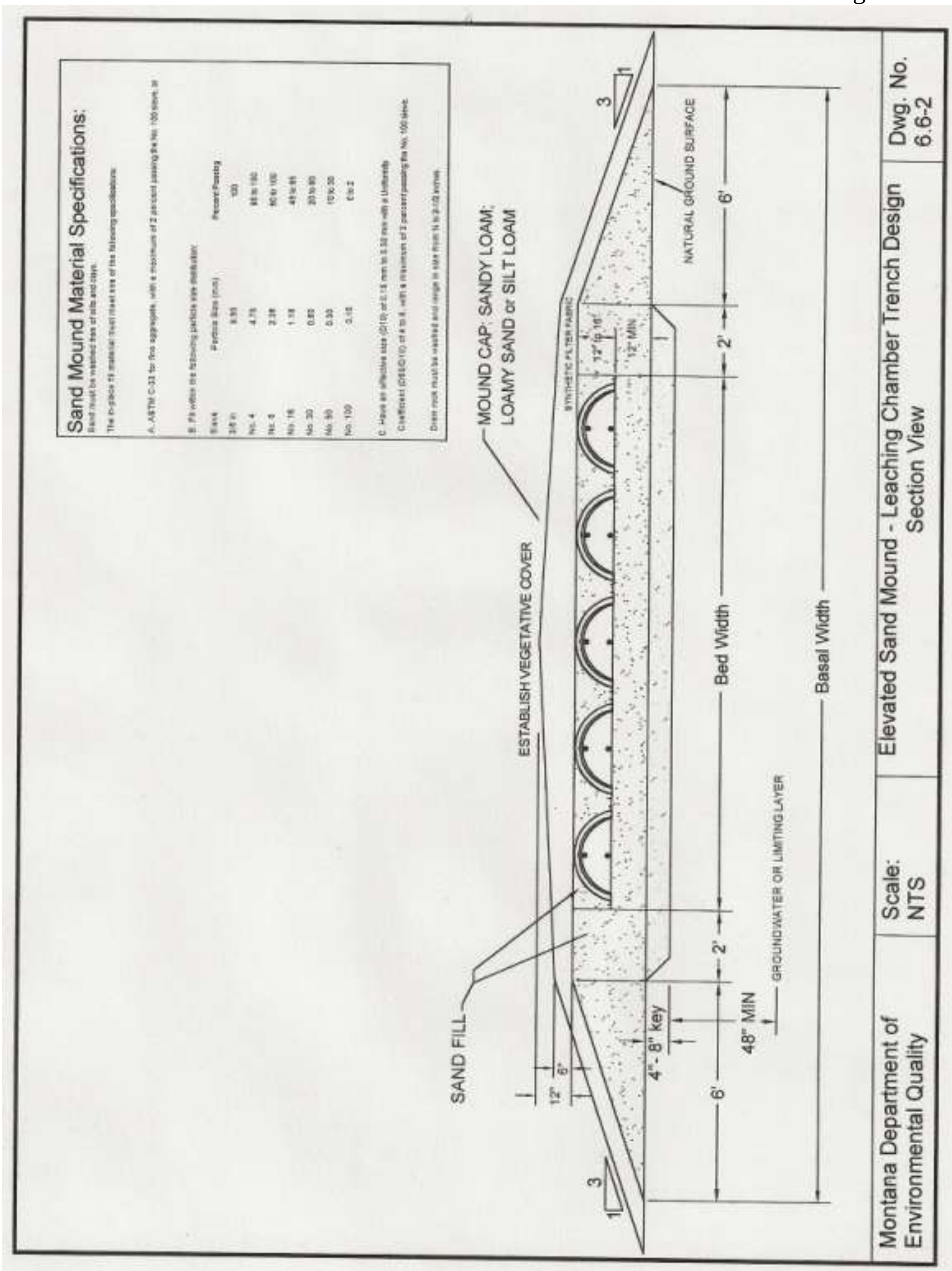
6.6.4.4 The area surrounding the elevated sand mound must be graded to provide ~~for~~ diversion of surface runoff waters.

6.6.4.5 Construction should be initiated immediately after preparation of the soil interface by placing ~~all of~~ the sand fill needed for the mound ~~(to the top of the trench)~~ to a minimum depth of 21 inches above the plowed surface. This depth will permit excavation ~~of trenches~~ in the sand fill to accommodate the 9 inches of drain rock necessary for the distribution piping. After hand leveling ~~of~~ the absorption area, the drain rock should be placed ~~into the trench~~ and hand leveled. An observation port into the gravel is recommended but not required. Filter fabric must be placed over the drain rock to separate the drain rock from the soil cover. After installation of the distribution system, the entire mound should be covered with 6 inches of a finer textured soil material, such as sandy loam to loam. A 4- to 6- inch layer of topsoil should then be added. The entire mound should be sloped to drain, either by providing a crown at the center or a uniform slope across the mound, with a minimum slope of 1 percent in either case. The entire mound must be seeded, sodded, or otherwise provided with shallow-rooted vegetative cover to ensure stability of the installation.

6.6.4.6 ~~The installation of the mound system must be inspected by the designer, who must certify that the system has been installed according to the approved design.~~ As-built plans may be required by the reviewing authority prior to final approval of the system.

~~14.1 Dosing system design Pressure distribution is required for the elevated sand mound system.~~


Sand Mound Material Specifications:
MOUND CAP: SANDY LOAM; LOAMY SAND or SILT LOAM
ESTABLISH VEGETATIVE COVER
SYNTHETIC FILTER FABRIC
SAND FILL
NATURAL GROUND SURFACE
GROUNDWATER OR LIMITING LAYER
12"
6"
4"- 8" key
48" MIN
24" MIN
12" MIN
5'-3"
2'
Bed Width
Basal Width
3
1
Montana Department of Environmental Quality
Scale: NTS
Elevated Sand Mound - Bed Design Section View
Dwg. No. 6.6-1


Sand Mound Material Specifications:
MOUND CAP: SANDY LOAM; LOAMY SAND or SILT LOAM
ESTABLISH VEGETATIVE COVER
SYNTHETIC FILTER FABRIC
12" to 18"
12" MIN
SAND FILL
12"
6"
4" - 8" key
48" MIN
GROUNDWATER OR LIMITING LAYER
NATURAL GROUND SURFACE
3
1
6'
2'
Bed Width
Basal Width
Montana Department of Environmental Quality
Scale: NTS
Elevated Sand Mound - Leaching Chamber Trench Design Section View
Dwg. No. 6.6-2

6.7 EVAPOTRANSPIRATION ABSORPTION AND EVAPORTANSPIRATION SYSTEMS

6.7.1 General

Evapotranspiration absorption (ETA) systems are used where slow percolation rates or soil conditions would preclude the use of a standard absorption system.

Percolation tests conducted in accordance with Appendix A must be conducted for all ETA systems, at the depth of the bottom of the bed, and must include at least a 24 hour presoak of the hole prior to the test.

Evapotranspiration systems (ET) are used where slow percolation rates or soil conditions would preclude the use of a soil absorption system or where discharge to the receiving soils is undesirable.

The primary difference between the ETA and ET system is the inclusion of a liner in ET systems.

ETA and ET systems should be used in conjunction with wastewater flow reduction strategies.

6.7.2 Location

6.7.2.1 ~~Evapotranspiration absorption (ETA)~~ ETA and ET systems must meet all minimum separation distances as stated in ARM Title 17, Chapter 36, subchapter 3 or 9. Distances must be measured from the edge of the system.

6.7.2.2 ETA and ET systems must meet all of the site requirements of Chapter 2.

6.7.2.3 ETA and ET systems ~~beds~~ must be level and must not be installed on land with a slope greater than 15 ~~6~~ percent. Protective berms or drainage trenches must be installed to divert storm drainage and snow-melt run-off away from the system.

6.7.3 Design

6.7.3.1 ETA and ET systems must not be deeper than 30 inches from finished grade.

6.7.3.2 The fill material in the ETA and ET system ~~must be at least 24 inches deep below the laterals and~~ must be washed coarse sand, drain rock or other inert media approved by the reviewing authority. ~~Testing~~ Information must be provided to document the void ratio used and the wicking characteristics of the material. ~~In this~~

~~application, drain rock larger than the orifice size up to a maximum of 6 inches in diameter may be used. ETA systems must utilize pressure distribution design~~.

6.7.3.3 ~~The beds~~ ETA and ET system must be installed with the long dimension parallel to the land contour. ~~A minimum of one lateral per ten feet of bed width is required.~~

6.7.3.4 ET systems must include a watertight liner of at least 30-mil thickness to contain the effluent. Seams for a synthetic liner must be completely sealed in accordance with the manufacturer's recommendations and the liner must be keyed into the native soils at its edges.

6.7.3.5 There must be a minimum of 2 inches of sand fill between the native soil surface and/or any projecting rocks and the liner.

6.7.3.6 Standard absorption trenches, gravelless trenches, other absorption trenches or distribution pipes may be used to distribute effluent in an ETA and ET system.

Standard absorption trenches, gravelless trenches and other absorption trenches must be constructed in accordance with Chapter 6.1 or Chapter 6.5 and this chapter. No reduction in absorption area sizing will be allowed for the use of gravelless or other trench technology in ETA or ET systems.

~~The distribution pipes must have drain rock extending to the bottom of the system. and be covered with a minimum of 2 inches of drain rock.~~

The spacing between standard absorption trenches, gravelless trenches, other trenches or distribution pipes in an ETA or ET system must be a minimum of 6 feet and maximum of 8 feet.

6.7.3.5 Soils with a percolation rate of 240 minutes per inch or faster must have an ETA system sized upon an application rate of at least 0.15 gpd/ft2. All calculations must be submitted for review.

Soils with a percolation rate of 241 minutes per inch or slower must have an ETA system sized upon a site specific application rate as determined in the field using the ASTM D5093-02 test procedure; however, the area of the ETA may not be smaller than one sized upon an application rate of 0.15 gpd/ft2. All calculations must be submitted for review.

6.7.3.6 Wastewater flow rates must be determined in accordance with Chapter 3.

6.7.3.7 Calculated storage capacity must provide a factor of safety of at least 1.5 for storage loss over time caused by plugging of the voids due to evaporated salts and residuals wastewater flow rates.

6.7.3.8 Water balance sizing calculations for ETA and ET systems must be based on a one year period. A water balance analysis may include: pan evaporation data, precipitation for the wettest year in a 10-year period, ~~average precipitation for a 10-year period~~, ~~and~~ soils absorption information from the site, transpiration, and other site-specific design information.

A. Pan evaporation information may be included in the water balance where it can be adequately demonstrated. Very few locations exist where data has been tabulated in Montana and calculations must address site specific pan evaporation conditions.

B. A soil application rate must be determined in accordance to the criteria of Section 6.7.3.5.

C. The design must show that total water lost through evaporation and absorption equals or exceeds the total water gained through precipitation and effluent discharge. Precipitation information used must be for the wettest year in a 10-year period ~~Due to lack of pan evaporation data, published information on pan evaporation, or data from a similar climatic location, may be used.~~ ~~Typically, The design must include a water balance for a one-year period~~. Storage capacity must be built into the system to accommodate months with low evaporation.

D. Transpiration may be included in the water balance where it can be adequately demonstrated.

E. Other site specific design information such as shade, area topography, or manmade structures may need to be considered.

6.7.4 Construction

6.7.4.1 Construction of an ET system must be initiated immediately after preparation of the liner.

6.7.4.2 Excavation for ETA systems may proceed only when the moisture content is below the soil's plastic limit. If a sample of soil taken at the depth of the proposed bottom of the system forms a ribbon ~~wire~~, instead of crumbling, when one attempts to roll it between the hands, the soil is too wet to excavate.

6.7.4.3 ~~The~~ ETA construction must be completed in such a manner to prevent compaction. ~~of the bed surface.~~ ~~The maximum depth from the top of the laterals distribution pipe to the surface of the topsoil must not exceed 18 inches.~~

~~The ETA construction must be completed in such a manner to prevent compaction of the bed surface. The maximum depth from the top of the laterals distribution pipe to the surface of the topsoil must not exceed 18 inches.~~

6.7.4.3 The ~~drain rock~~ fill material must be covered completely with drainage fabric, ~~layers of untreated construction paper,~~ or 2 inches of straw to prevent the soil cover from entering the media.

~~The backfill topsoil material must be loamy sand or sandy loam. The maximum depth from the top of the laterals to the surface of the topsoil must not exceed 18 inches. The topsoil cap must be between 6 to 12 inches in depth. It must be mounded above natural grade, with a minimum of one percent slope, to allow for settling and to direct runoff away from the system.~~

6.7.4.4 A 4-inch diameter, standing check pipe with both ends capped (only the bottom cap should be glued) must be installed. Several 1/8-inch to ¼-inch diameter holes should be drilled in the bottom half of the pipe and covered with a filter cloth sock. Check pipe should be anchored in fill material to prevent the pipe from being pulled out of the ~~bed~~ system.

6.7.4.5 The ETA and ET system must be covered with a minimum of 12 inches at the center of the system and 6 inches at the edge of the system of a suitable medium, such as sandy loam, loamy sand or silt loam, to provide drainage and aeration. These depths are measured after settling.

The topsoil cap must be immediately vegetated after construction with sod or other appropriate method.

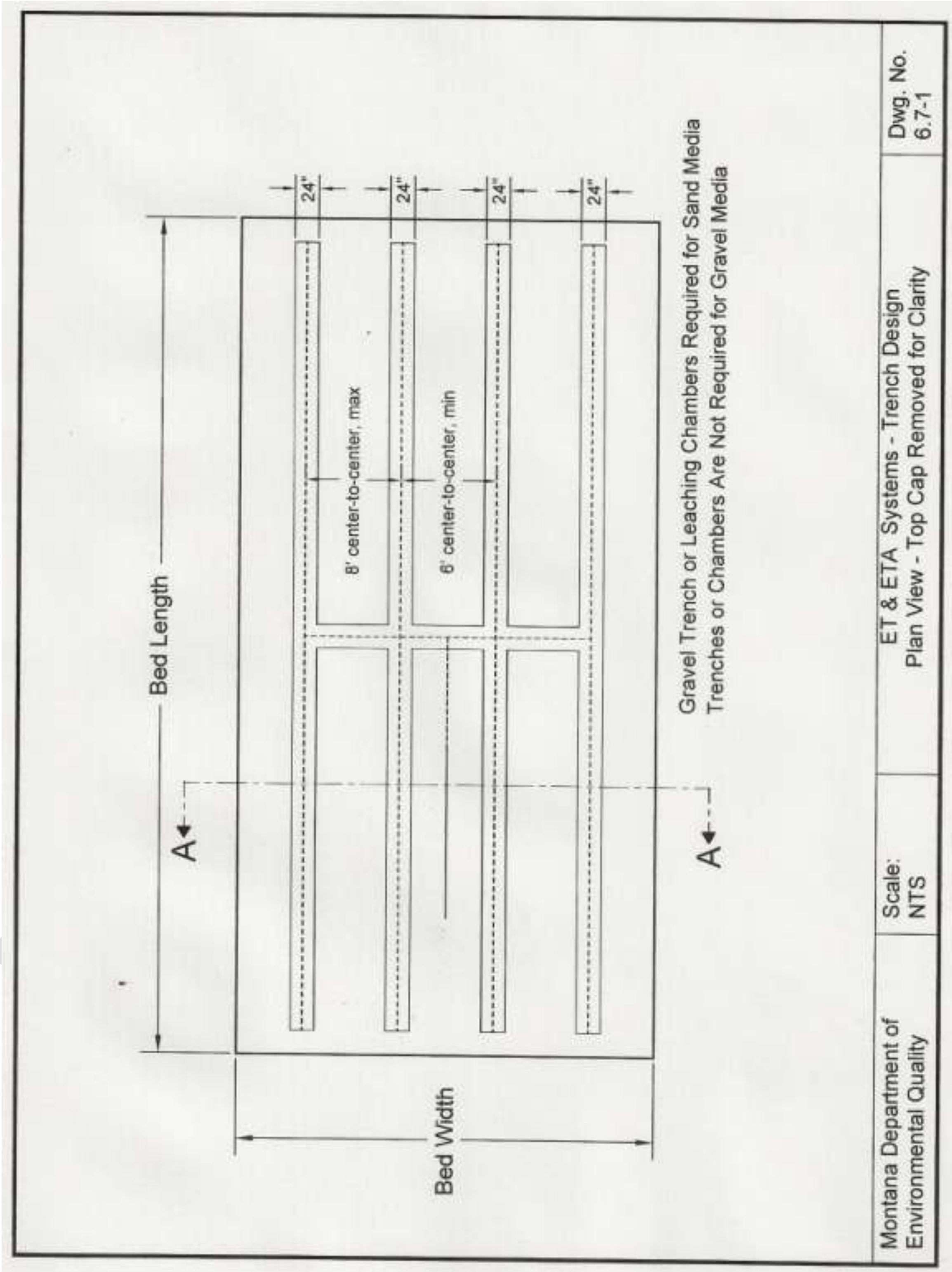
6.7.4.6 A berm surrounding the ~~bed~~ system must be constructed to ensure that storm water or other runoff does not enter the ~~bed~~ system.

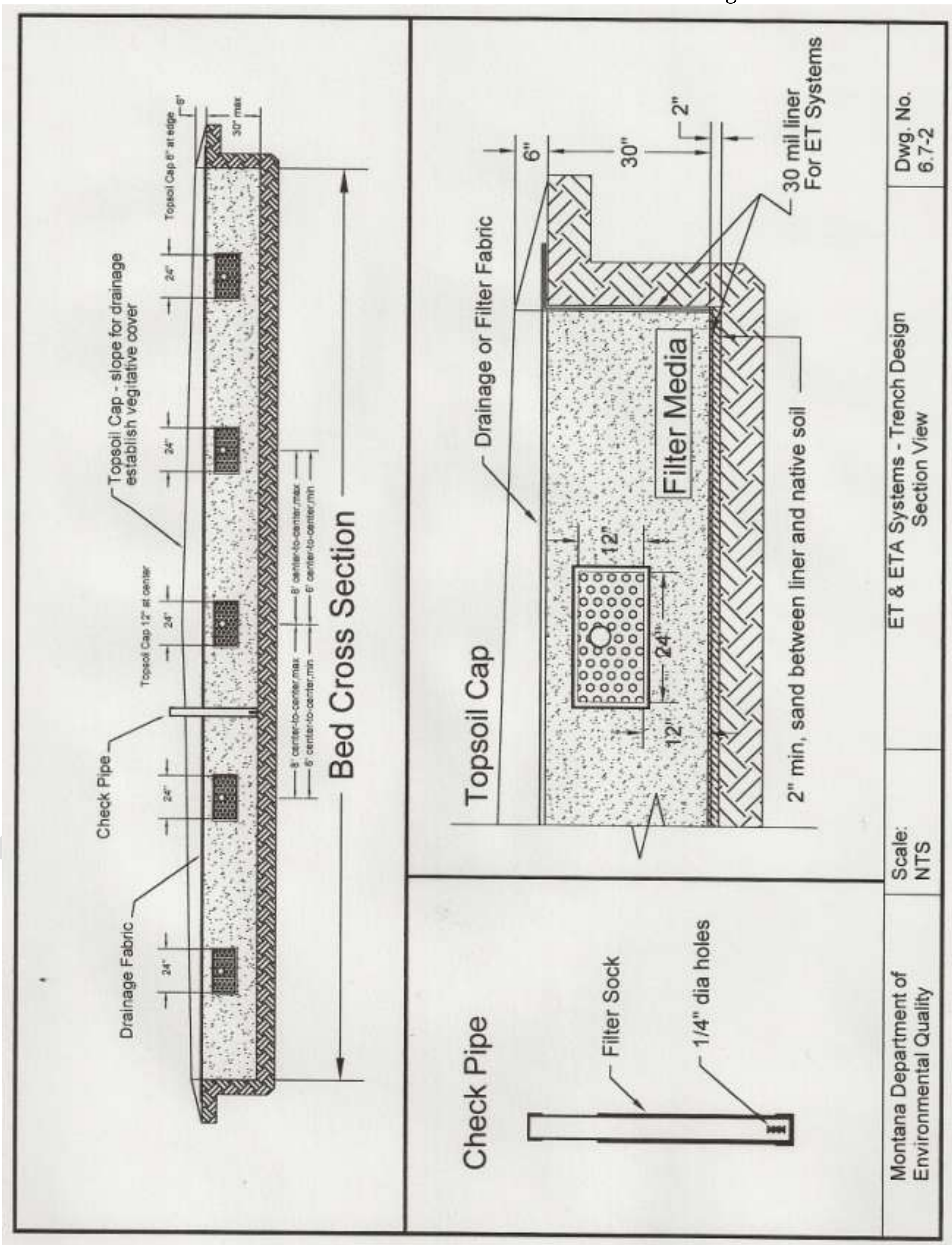
6.7.4.7 ~~The backfill topsoil material must be loamy sand or sandy loam. The maximum depth from the top of the laterals distribution pipe to the surface of the topsoil must not exceed 18 inches. The topsoil cap must be between 6 to 12 inches in depth. It must be mounded above natural grade, with a minimum of one percent slope, to allow for settling and to direct runoff away from the system. The topsoil cap must be immediately vegetated after construction with sod or other appropriate method.~~

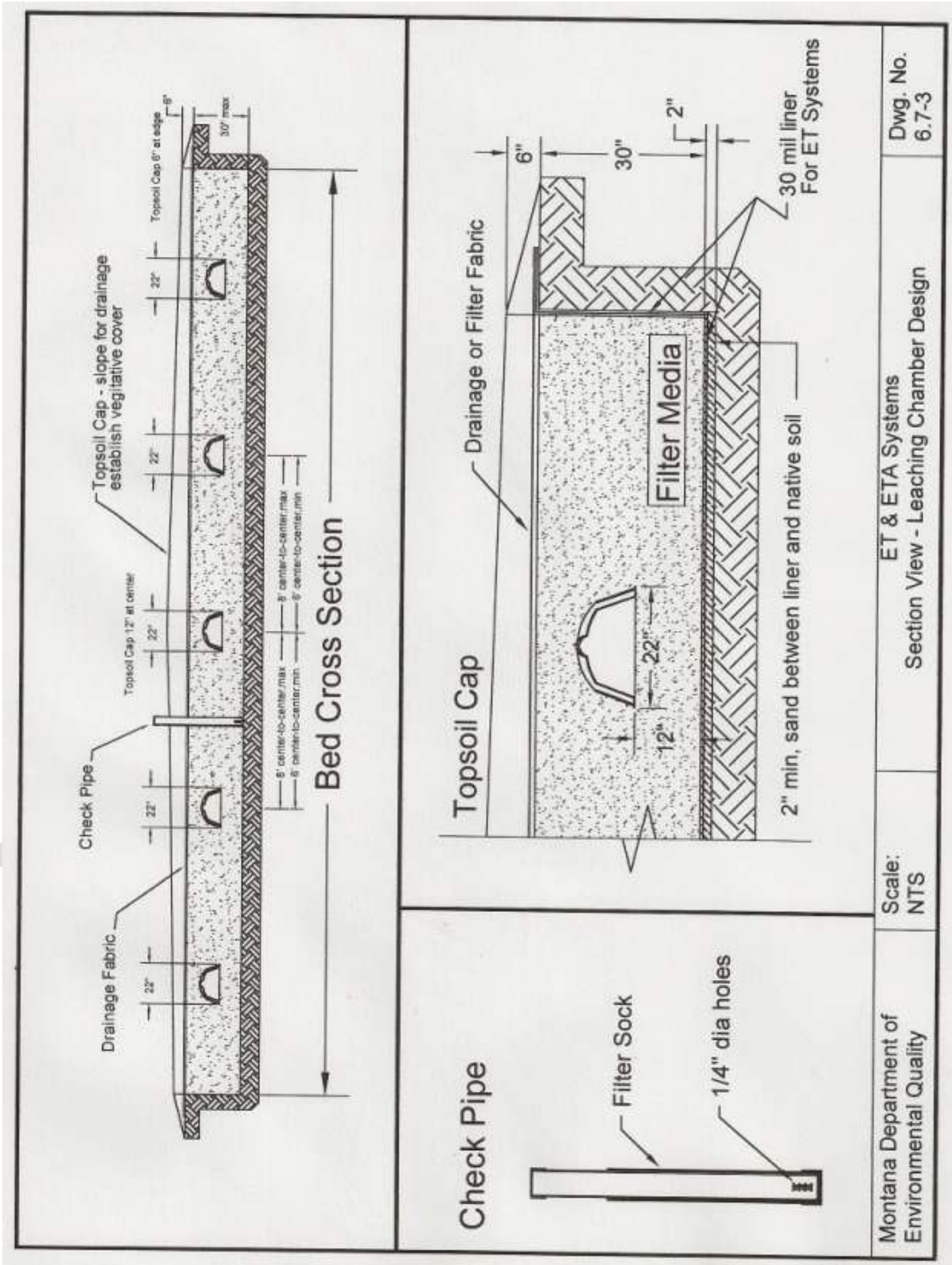
6.7.4.8 ~~If the system is intended to remove nitrogen, a complete description of the nitrification and denitrification processes must be provided in detail, including the unit where it occurs, carbon source, feed rates, loading rates, pumps, controls, and other mechanisms necessary.~~

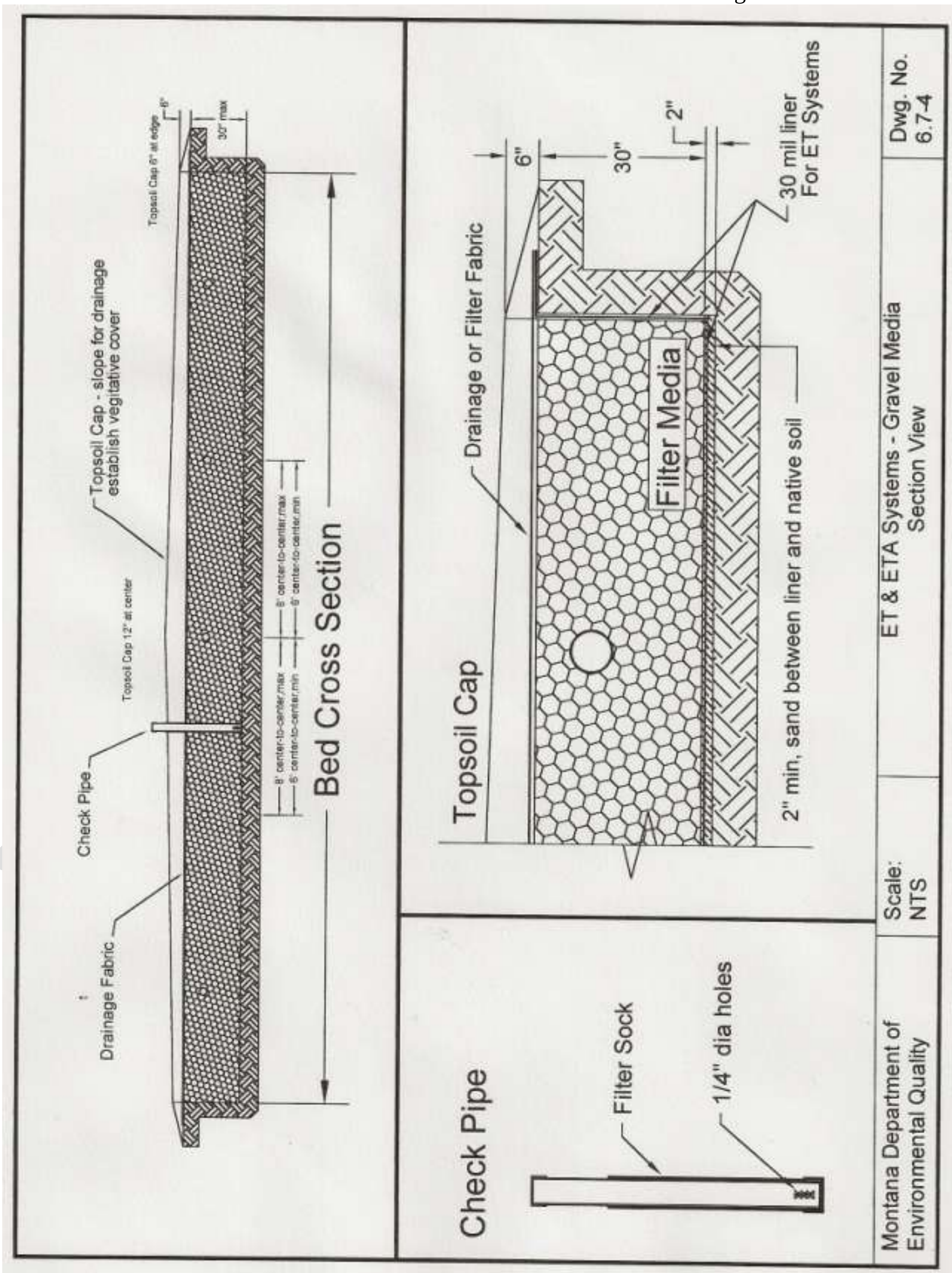
6.7.5 Operation and Maintenance

A detailed set of plans and specifications and an operation and maintenance ~~manual~~ plan are required. The operation and maintenance plan must meet the requirements in Appendix D.


Bed Length
Bed Width
24"
24"
24"
24"
8' center-to-center, max
6' center-to-center, min
A
A
Gravel Trench or Leaching Chambers Required for Sand Media
Trenches or Chambers Are Not Required for Gravel Media
Montana Department of Environmental Quality
Scale: NTS
ET & ETA Systems - Trench Design
Plan View - Top Cap Removed for Clarity
Dwg. No. 6.7-1


Topsoil Cap - slope for drainage establish vegitative cover
Check Pipe
Drainage Fabric
Topsoil Cap 6" at edge
Topsoil Cap 12" at center
6"
30" max
24"
24"
24"
24"
24"
8' center-to-center,max
6' center-to-center,min
Bed Cross Section
Drainage or Filter Fabric
Topsoil Cap
Filter Media
6"
30"
2"
12"
24"
12"
30 mil liner For ET Systems
2" min, sand between liner and native soil
Check Pipe
Filter Sock
1/4" dia holes
Montana Department of Environmental Quality
Scale: NTS
ET & ETA Systems - Trench Design Section View
Dwg. No. 6.7-2


Topsoil Cap - slope for drainage establish vegitative cover
Topsoil Cap 6" at edge
6"
30" max
22"
Topsoil Cap 12" at center
Check Pipe
Drainage Fabric
8' center-to-center max
6' center-to-center min
Bed Cross Section
Topsoil Cap
Drainage or Filter Fabric
6"
30"
2"
30 mil liner
For ET Systems
Filter Media
22"
12"
2" min, sand between liner and native soil
Check Pipe
Filter Sock
1/4" dia holes
Montana Department of
Environmental Quality
Scale:
NTS
ET & ETA Systems
Section View - Leaching Chamber Design
Dwg. No.
6.7-3


Topsoil Cap - slope for drainage establish vegitative cover
Topsoil Cap 6" at edge
6"
30" max
Check Pipe
Topsoil Cap 12" at center
Drainage Fabric
8' center-to-center max
6' center-to-center min
Bed Cross Section
Drainage or Filter Fabric
6"
30"
2"
30 mil liner
For ET Systems
Filter Media
Topsoil Cap
2" min, sand between liner and native soil
Check Pipe
Filter Sock
1/4" dia holes
Montana Department of
Environmental Quality
Scale:
NTS
ET & ETA Systems - Gravel Media
Section View
Dwg. No.
6.7-4

~~6.8 EVAPOTRANSPIRATION SYSTEMS~~

6.8.1 ~~General~~

~~Evapotranspiration systems (ET) are used where slow percolation rates or soil conditions would preclude the use of a soil absorption system.~~

~~ET systems should be used in conjunction with wastewater flow reduction strategies.~~

6.8.2 ~~Location~~

6.8.2.1 ~~Evapoptranspiration (ET) ET systems must meet all minimum separation distances in ARM Title 17, chapter 36, subchapter 3 or 9. Distances must be measured from the edge of the liner.~~

6.8.2.2 ~~ET systems must meet all of the site requirements of Chapter 3.1 and 3.2~~

6.8.2.3 ~~ET systems may not be installed on land with a slope greater than 6 15 percent.~~

6.8.3 ~~Design~~

6.8.3.1 ~~The material in the ET system must not be deeper than 30 inches from finished grade. be at least 24-inches deep and must be washed coarse sand or drain rock.~~

6.8.3.2 ~~The fill material in the ET system must be at least 24 inches deep below the laterals and must be washed coarse sand, drain rock, or other inert media approved by the reviewing authority. Testing Information must be provided to document the void ratio used and the wicking characteristics of the material.~~

6.8.3.3 ~~ET systems must be installed with the long dimension parallel to the land contour.~~

~~Design~~

6.8.3.4 ~~A watertight liner of at least 30-mil thickness must be installed to contain the effluent. Seams for a synthetic liner must be completely sealed in accordance with the manufacturer's recommendations and the liner must be keyed into the native soils at its edges.~~

6.8.3.5 ~~There must be a minimum of 2 inches of sand fill between the native soil surface and/or any projecting rocks and the liner.~~

6.8.3.6 ~~Standard absorption trenches, gravelless trenches or distribution pipes may be used to distribute effluent in an ET system.~~

~~Standard absorption trenches and gravelless trenches must be constructed in accordance with Chapter 6.1 or Chapter 6.5 and this chapter. No reduction in absorption area sizing will be allowed for the use of gravelless trench technology in ET systems.~~

~~Designs utilizing washed course sand as a fill material must use either standard absorption trenches or gravelless trenches for effluent distribution. The distribution pipes must have drain rock extending to the bottom of the system. and be covered with a minimum of 2 inches of drain rock.~~

~~The spacing between standard absorption trenches, gravelless chambers or distribution pipes in an ET system must be a minimum of 6 feet and maximum of 8 feet.~~

~~Drain rock must be placed around the distribution pipes. The Distribution pipes The pipes must be installed with the long dimension parallel to the land contour. The minimum spacing between pipes must be 6 feet, and the maximum spacing must be 8 feet~~

6.8.3.7 ~~Wastewater flow rates must be determined in accordance with Chapter 3.1.~~

6.8.3.8 ~~The volume of the ET system will~~ must ~~be based on water balance sizing calculations for a one year period.~~

6.8.3.9 ~~Calculated storage capacity must provide a factor of safety of 1.5 for storage loss over time caused by plugging of the voids due to evaporated salts and residuals.~~

6.8.3.10 ~~A one year water balance analysis includes: pan evaporation~~ data, ~~precipitation for the wettest year in a 10-year period, average precipitation for a 10-year period, and soils absorption information from the site, transpiration, and other site-specific design information.~~

~~A. Pan evaporation information may be included in the water balance where it can be adequately demonstrated. Very few locations exist where data has been tabulated in Montana and calculations must address site specific pan evaporation conditions.~~

~~B. The design must show that total water lost through evaporation and absorption equals or exceeds the total water gained through precipitation and effluent discharge. Precipitation information used must be for the wettest year in a 10-year period Due to lack of pan evaporation data, published information on pan evaporation, or data from a similar climatic location, may be used. Typically, The design must include a water balance for a one-year period. Storage capacity must be built into the system to accommodate months with low evaporation.~~

~~C. Transpiration may be included in the water balance where it can be adequately demonstrated.~~

~~D. Other site specific design information such as shade, area topography, or manmade structures may need to be considered.~~

6.8.4 ~~Construction~~

6.8.4.1 ~~Construction should be initiated immediately after preparation of the liner. by placing all of the fill needed to a minimum depth of 24 inches. Trench sidewalls should be protected by placing synthetic filter fabric as a liner when the media is coarse sand.~~

6.8.4.2 ~~The bottom of each trench or bed ET system must be level throughout to ensure uniform distribution of effluent.~~

~~The distribution pipes must have 6 inches of drain rock underneath and must be covered with a minimum of 2 inches of drain rock.~~

6.8.4.3 ~~The drain rock fill material must be covered completely with drainage fabric or 2 inches of straw to prevent the soil cover from entering the media. The gravel or rock filter media must be covered completely with synthetic drainage fabric to prevent the soil cover from entering the media.~~

6.8.4.4 ~~A 4-inch diameter, standing check pipe with both ends capped (only the bottom cap should be glued) must be installed. Several 1/8-inch to ¼-inch diameter holes should be drilled in the bottom half of the pipe and covered with a filter cloth sock. Check pipe should be anchored in fill material to prevent the pipe from being pulled out of the bed system.~~

6.8.4.5 ~~The ET system must be covered with a minimum of 12 inches at the center of the ET system and 6 inches at the edge of the ET system of a suitable medium, such as sandy loam, loamy sand or silt loam, to provide drainage and aeration. These depths are measured after settling.~~

~~The topsoil cap must be immediately vegetated after construction with sod or other appropriate method~~

~~The backfill topsoil material must be loamy sand or sandy loam. The maximum depth from the top of the laterals to the surface of the topsoil must not exceed 18 inches. The topsoil cap must be between 6 to 12 inches in depth. It must be mounded above natural grade, with a minimum of one percent slope, to allow for settling and to direct runoff away from the system.~~

6.8.4.6 ~~A berm surrounding the bed system must be constructed to ensure that storm water or other runoff does not enter the bed. The berm must be 6 to 12 inches above the natural grade of the site.~~

6.8.4.7 ~~If the system is intended to remove nitrogen, a complete description of the nitrification and denitrification processes must be provided in detail, including the unit where it occurs, carbon source, feed rates, loading rates, pumps, controls, and other mechanisms necessary.~~

6.8.5 ~~Operation and Maintenance~~

~~A detailed set of plans and specifications and an operation and maintenance plan are required. The operation and maintenance plan must meet the requirements in Appendix D.~~

6.8 SUBSURFACE DRIP

6.8.1 General

Subsurface drip systems are an efficient method for dispersal of wastewater and/or gray water into the soil in small volume doses throughout the day. Uniformly spaced drip emitters in flexible polyethylene tubing control the rate of wastewater discharge and are available in either turbulent flow or pressure compensating configurations.

Each emitter's pressure compensating feature controls discharge at a nearly constant rate along the entire drip line lateral's length over a wide range of pressures. Typically, the drip line is installed directly into the soil without aggregate or other media. Pumps fill and pressurize the drip line sufficiently to achieve uniform distribution.

Monitoring system function and performance along with effluent metering is essential to proper operation. The subsurface drip system is typically operated by an integrated controller programmed to activate the pumps to dose the drip line at appropriate intervals and duration. The controller must be programmable to perform a forward flush of the drip line and back flushing of a filter. The controller should also store operating data for documenting system performance and diagnosing system malfunctions.

No reduction in absorption field size will be granted for advanced wastewater treatment systems.

6.8.2 Location

Subsurface drip systems must meet the site evaluation criteria of Chapter 2.

Subsurface drip systems must meet the location criteria in ARM Title 17, Chapter 36, subchapter 3 or 9. The subsurface drip system may not be located where vehicles will cross the drip lines. Potable water lines may not pass under or through any part of the dispersal system.

Each submittal must address how the service provider can access the subsurface drip system for maintenance and how property use can be controlled to prevent unauthorized access to components.

6.8.3 Design

6.8.3.1 Wastewater Quantity and Quality Characterization

The quantity of expected wastewater or gray water shall be estimated using the guidelines outlined in Chapter 3 or Chapter 6.9.

Wastewater and gray water entering a subsurface drip system must include both primary and advanced treatment as described in this Circular.

6.8.3.2 Materials

All subsurface drip system materials must be warranted by the manufacturer for use with sewage and be resistant to plugging from solids, bacterial slime and root intrusion.

Fittings used to join the drip line to the distribution line and for flushing the manifolds must be installed in accordance with manufacturer's recommendations. Either compression or barb fittings may be specified, depending on the manufacturer recommendations and system operating pressure.

6.8.3.3 System Components

A. Primary Treatment

All subsurface drip systems must include a septic tank in compliance with Chapter 5.

B. Advanced Wastewater Treatment System

An advanced wastewater treatment system is required to meet minimum wastewater characteristic criteria prior to final subsurface disposal.

C. Dosing System

Uniform pressure distribution designed in accordance with Chapter 4.3 must be provided for all subsurface drip systems.

All subsurface drip systems should operate between 15 to 45 psi.

Timed dosing is required on all systems. A minimum number of twelve (12) equally spaced doses per day are required in all soil types. A method to track and verify dosing volumes and times, such as a digital control panel, pump elapsed time meters (ETMs), event counters, etc., must be provided.

D. Pumps/System Flushing

Pump selection must take into account the operating volume and pressure for the drip dispersal field when calculating the total dynamic head required for filter flushing and/or back flushing, field dosing, and drip line flushing. All disposal and flushing parameters must fall within the operational range of the pump selected.

All subsurface drip systems must include means to backwash the filters and flush drip lines and manifolds.

Filter backwash and drip line flushing must be automatic. Filter backwash and drip line flushing must be accomplished according to manufacturer's recommendations to prevent damage to the drip line and maintain product warranty.

Filter backwash and drip line flushing debris must be returned to the septic tank or the primary treatment tank.

Hose bibs are not allowed for use as a flushing component (to prevent cross contamination of potable water supply).

Field flushing velocity must be designed at the distal end of each drip line lateral connection. This velocity must be the same as required by the drip line manufacturer.

The flush return volume may not exceed the hydraulic capacity of the pretreatment unit.

E. Supply and Return Manifolds

Both supply and return manifolds are required on all subsurface drip systems.

All piping, valves, fittings, level control switches, and all other components must be designed and manufactured to resist the corrosive effects of wastewater and common household chemicals.

F. Drip line/Dispersal Line

Drip line tubing is typically a flexible polyethylene (PE) available in several diameters with a nominal ½ inch as the typical size in wastewater applications.

The drip line must be color coded purple by the manufacturer to be easily recognized as suitable for subsurface drip dispersal.

The drip line must be warranted fully by the manufacturer for protection against root intrusion for a minimum period of ten (10) years.

Drip lines should always be installed as level as possible on the contour line.

Drip lines must be installed to facilitate positive drainage back to the manifold. No standing water may pool within the system. Subsurface drip systems located on sloped sites must be designed and installed to prevent drainage to lower elevated components (drip lines, tanks, valve boxes, etc.).

Minimum installation depth for drip lines and manifolds is 8 inches beneath grade.

Drip lines should be installed on 2 feet centers.

G. Emitters

Emitter size and type must be specifically designed for use in a subsurface drip system.

All subsurface drip systems must be equipped with self cleaning, pressure compensating or turbulent flow emitters.

Emitters must be installed on 2 foot intervals along the drip line with an effective subsurface infiltrative area of 4 square feet. This spacing may be altered for specific reuse systems per both the manufacturers recommendations and the reviewing authority's approval. Spacing of emitters closer than 2 feet does not change the required subsurface infiltrative area.

The discharge rate of any two emitters may not vary by more than 10% in order to ensure that the effluent is uniformly distributed over the entire drip line lateral.

H. Filters

Designers shall specify the filter that is recommended by the drip line manufacturer.

All filters used must be resistant to corrosion. The manufacturer shall warrant the filters for wastewater use.

All filters must be sized to operate at a flow rate at least equal to the maximum design discharge rate of the system. Filter backwash must be included in calculating the maximum discharge rate (where applicable).

Filters may either require backwashing in accordance with manufacturer's recommendations or may be the continuously self-cleaning type.

All subsurface drip system filters must be readily accessible for inspection and servicing.

I. Flow Meter

Flow meters or some other means to monitor flow must be installed in a readily accessible location for reading and servicing. Flow meters must be warranted by the manufacturer for use with wastewater and must be accurate within the expected flow range of the installed system

J. Electronic control panel

A controller capable of timed dosing and automatic line/filter flushing is required for all systems.

K. Air/Vacuum Relief Valve

Air/vacuum relief valve(s) must be installed at the high point(s) of each supply or return manifold. All valves must be installed in a valve box with access to grade and include a gravel sump. Designs should include a minimum of two air/vacuum relief valves per drip zone. They should be located at the highest point(s) of both the supply and flush manifolds and are typically placed in a valve box lined with gravel for protection. They must have constant venting to the atmosphere.

L. Control Valves

Valves must be readily accessible for inspection and/or service (such as in a valve box with access to grade).

Control valves used for system flushing and zone distribution must operate automatically.

Pressure regulators are recommended for all subsurface drip systems.

Pressure gauge access points (Schrader valves or equal) are required at appropriate locations on system networks utilizing turbulent flow emitters to verify design and operational performance. Pressure gauge access points are recommended to be installed on all systems.

6.8.3.4 Sizing

Subsurface drip systems must be sized in accordance with soil descriptions of Table 2.1-1 and Appendix B. Unless otherwise approved by the reviewing authority, the effective width of the absorption area will be 2 feet per drip line.

6.8.3.5 All subsurface drip systems must be designed to remain free flowing during freezing conditions.

6.8.4 Construction

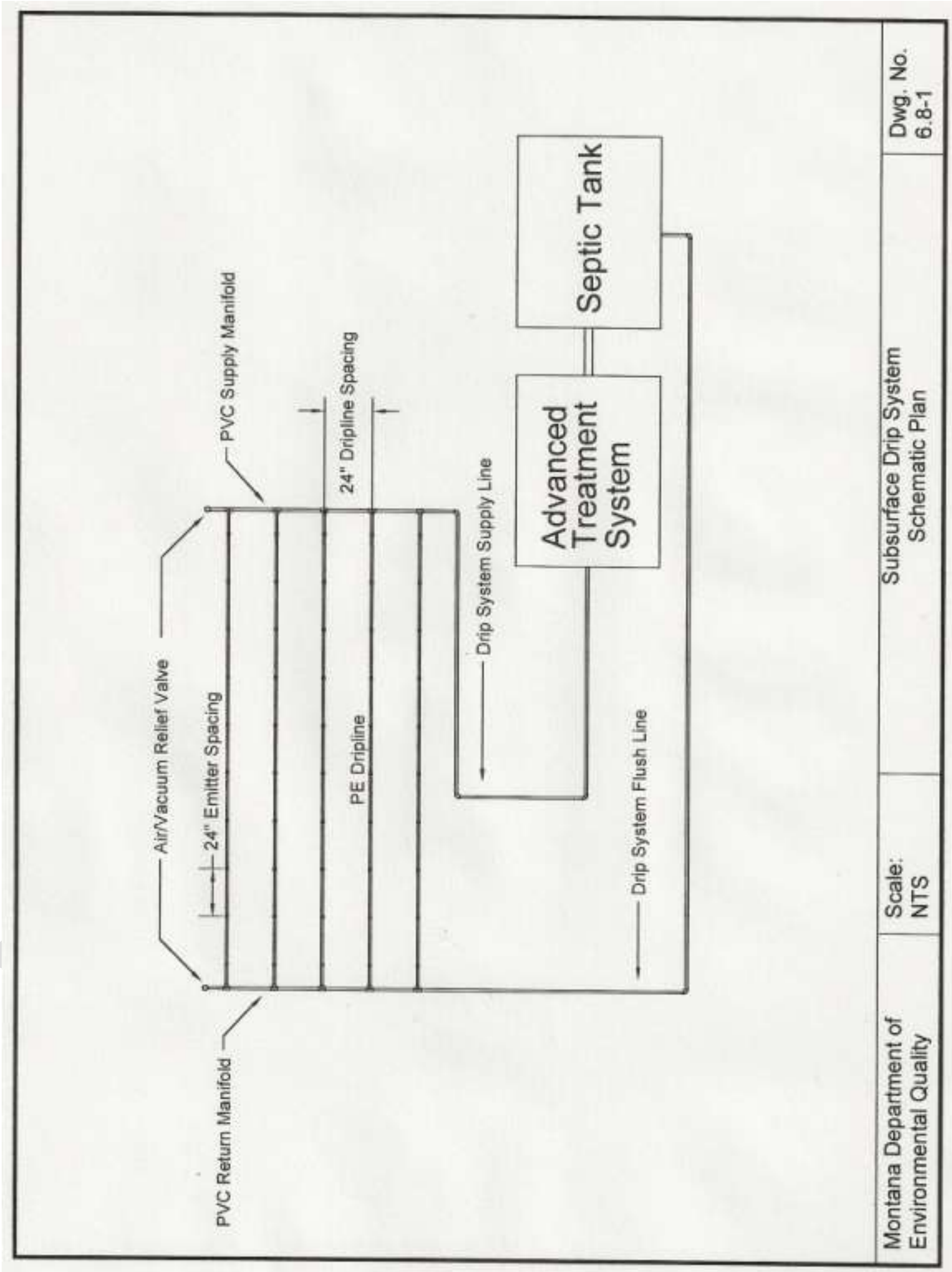
Installation instructions and recommendations vary from one manufacturer to another. Installation knowledge and skill may be product-specific. Installers are responsible for obtaining proper training before attempting to install subsurface drip systems.

A ground cover (turf or other appropriate landscaping) must be planted over the dispersal field after installation to prevent erosion.

In addition to these standards, all systems must be constructed in accordance with manufacturer's recommendations.

6.8.5 Operation and Maintenance

A detailed set of plans and specifications and an operation and maintenance plan are required for all components of the system. The operation and maintenance plan must meet the requirements outlined in Appendix D.


PVC Supply Manifold
24" Dripline Spacing
Air/Vacuum Relief Valve
24" Emitter Spacing
PE Dripline
PVC Return Manifold
Drip System Supply Line
Drip System Flush Line
Advanced Treatment System
Septic Tank
Montana Department of Environmental Quality
Scale: NTS
Subsurface Drip System Schematic Plan
Dwg. No. 6.8-1

6.9 GRAY WATER IRRIGATION SYSTEMS

6.9.1 General

Gray water is untreated wastewater collected from bath tubs, showers, lavatory sinks, clothes washing machines, and laundry tubs. Gray water systems used in conjunction with a waste segregation system may also use wastewater collected from kitchens. Gray water can be contaminated with organic matter, suspended solids or microorganisms that are potentially pathogenic. In general, treatment and disposal of gray water is subject to all applicable provisions in this Circular, except that gray water may be used for irrigation as provided in this chapter.

~~Except as provided in 6.10.2 32.1.2, subsurface treatment and disposal of gray water must be by means of a wastewater treatment system that meets all applicable requirements of this Circular.~~

Gray water reuse within a building or residence for uses such as toilet flushing is permitted without review, provided that the gray water is ultimately disposed by means of an approved wastewater treatment system that meets all applicable requirements of this Circular.

Gray water irrigation systems that meet the requirements of this chapter are not subject to the other chapters in this Circular, except as specifically referenced in this chapter.

6.9.2 Location

Gray water irrigation systems must meet the location criteria for gray water reuse set out in ARM Title 17, Chapter 36, subchapter 3 or 9.

6.9.3 Design

6.9.3.1 The collection, storage and distribution portions of a gray water irrigation system must be designed in accordance with this chapter. The reviewing authority may allow the use of other designs and material pursuant to the review of manufacturer's information and data to substantiate the proposed alternative.

6.9.3.2 Except for lots with waste segregation systems, lots with gray water irrigation systems must be served by an existing approved alternate wastewater treatment system that is adequate to treat both the gray water and the other wastewater from the lot. Lots with waste segregation systems must have an alternate approved waste water treatment system for treating gray water, although the system need not be installed if gray water irrigation is conducted pursuant to this chapter.

6.9.3.3 Gray water from kitchen sources may be used for irrigation only where a waste segregation system is used.

6.9.3.4 All effluent from sources that are not gray water must be disposed of in an approved wastewater system.

6.9.3.5 The reviewing authority may require sampling data to insure that the strength of gray water used for irrigation does not exceed typical residential strength parameters.

6.9.3.6 Gray water irrigation systems must use subsurface dispersal. All systems must be a minimum of 6 inches below the ground surface. Ponding or water surfacing may not occur at any gray water irrigation location.

6.9.3.7 Gray water irrigation system designs may be augmented with ~~either~~ potable water. ~~or storm water collected from roofs. Storm water harvesting systems may need an application for a water right from the Department of Natural Resources and Conservation.~~

6.9.3.8 All gray water irrigation system piping and appurtenances must be easily identifiable as non-potable through the use of purple piping and continuous marking at a minimum of 4-foot intervals. Tanks, pumps and other equipment must also be labeled as "non-potable" using a permanent label placed in a conspicuous location.

6.9.3.9 If a gray water irrigation system is proposed for a lot served by a public wastewater system, the reviewing authority may not approve the gray water system unless the managing entity of the public system provides a letter of approval.

~~Design~~

6.9.3.10 Gray water design flow rates must be estimated as follows:

A. Estimated Residential Flow Rates:

To determine total flow rate for the gray water irrigation system the number of occupants must be multiplied by the estimated flow shown in Table 6.10-1.

<u>Table 6.9-1</u>

i.	Number of occupants per residential dwelling unit:	
	1st bedroom	2
	Each additional bedroom	1
ii.	Flow for each occupant is:	
	Showers, tubs, washbasins	25gpd
	Laundry	15 gpd
	Kitchen	10 gpd

B. Estimated Non- Residential Flow Rates:

Non-residential flow rates must be substantiated by the system designer in order to be approved by the reviewing authority.

6.9.3.11 Gray water irrigation systems must have a minimum absorption area based on soil types as described in accordance with Table 2.1-1 and Appendix B and Section 6.1.4.

6.9.3.12 If potable water is used to augment gray water for irrigation within the same distribution network, a method of backflow prevention for the potable water source must be included that is consistent with the requirements of ARM Title 17, Chapter 38, subchapter 3.

6.9.3.13 Gray water irrigation systems that are not designed to prevent freezing must be used in conjunction with a supplemental year-round method for wastewater treatment and disposal that meets applicable state and local requirements.

6.9.3.14 Except for lots with waste segregation systems, gray water irrigation systems must include a three way diverter valve to easily direct gray water to the year-round wastewater treatment system when needed. A backflow prevention device must be installed to prevent whole house wastewater from entering the gray water irrigation system.

6.9.3.15 The year-round wastewater treatment system must be sized to accept and treat the total flow from the gray water irrigation system together with any other effluent in the system

6.9.3.16 A gray water irrigation system may not adversely impact the functioning of the year-round wastewater treatment system.

~~The consultant~~ applicant ~~must demonstrate 4 feet of natural soil separation between the bottom of the gray water system and a limiting layer.~~

6.9.3.17 Gray water systems may be installed in fill.

6.9.4 Collection and Distribution

6.9.4.1 Hose bib or hose type attachments, including frost-free hydrants, may not be present on a gray water irrigation system.

6.9.4.2 The design must include appropriate valves or other methods to isolate the surge tank, irrigation zones, and connection to a wastewater treatment system.

~~The volume of any storm water collected from roofs and diverted to the gray water system must be included in the design capacity. If the system contains a surge tank, the roof storm water collection system must include an approved diversion valve to limit the volume discharged to the surge tank.~~

6.9.4.3 Surge tanks may be incorporated into a gray water irrigation system design. Surge tanks allow for uniform distribution of the gray water despite variable flow from the source. If a gray water irrigation system contains a surge tank, the tank must meet the following requirements:

A. Surge tanks used for the storage and distribution of gray water must be designed by the manufacturer for use with wastewater.

B. Surge tanks must be easily accessible for maintenance.

C. Surge tanks must be covered.

D. The minimum capacity of the surge tank must be 50 gallons.

E. Surge tanks may be installed either inside or outside a building, above or below ground.

F. Above-ground surge tanks must be installed on a level, three inch concrete slab or equivalent, and must be anchored to prevent overturning.

G. Below ground surge tanks must be installed in dry, level, well-compacted soil. Buoyancy of the surge tank must be prevented with appropriate construction where high groundwater exists.

H. Surge tanks must be equipped with an overflow pipe of the same diameter as the gray water influent pipe. The overflow must be permanently connected to an approved wastewater treatment system. This connection should be made to the building sewer, or septic tank, if any. The overflow drain may not be equipped with a shutoff valve. For waste segregation systems without an approved alternate wastewater treatment system installed, the overflow from the surge tank must be connected to a second surge tank. The second surge tank must also connect to the gray water irrigation system.

I. Above ground surge tanks must be equipped with an emergency drain of the same diameter as the gray water influent pipe. The emergency drain must be permanently connected to an approved wastewater treatment system. This connection should be made to the building drain, building sewer, or septic tank, if any.

J. The surge tank must include a method of backflow prevention that complies with ARM Title 17, Chapter 38, subchapter 3. ~~17.38 Chapter 3.~~

K. Surge tanks must be plumbed and vented in accordance with the Uniform Plumbing Code.

L. If storage time within the collection system is going to exceed 24 hours, appropriate treatment for odor control may be necessary.

6.9.4.5 All gray water irrigation systems should include a filter to prevent the buildup of solids and to insure proper system functioning. If no filter is included in the design, at least three valved irrigation zones must be designated. Each irrigation zone must have the required length of trench to accommodate the entire gray water flow per day with automatic valves to rotate the distribution of gray water between irrigation zones.

6.9.4.6 Gravity fed absorption trenches may not exceed 100 feet in length.

6.9.4.7 All pressure dosed gray water irrigation systems must meet the following minimum requirements:

A. Surge tanks must provide sufficient access to allow maintenance of the tank and pumps.

~~and Surge tanks using a siphon should have a dose counter installed to check for continued function of the siphon; and~~

B. High-water alarms must be provided for all surge tanks utilizing pumps.~~; and~~

C. The minimum dose volume must be equal to the drained volume of the discharge line and manifold plus a volume equal to at least 2 times the lateral volume.~~; and~~

D. The duration of each discharge should not exceed 15 minutes to promote uniform distribution and soil absorption.~~; and~~

E. The reserve volume of the dosing system surge tank must be at least equivalent to 25% of the design flow. This reserve volume is computed from the high-level alarm.~~; and~~

F. Cleanouts must be provided at the end of every lateral. Cleanouts must be within 6 inches of finished grade and should be made with either a long sweep elbow or two 45 degree bends.~~; and~~

G. Dosed irrigation systems should be field-tested to verify uniform distribution.

6.9.5 Operation and Maintenance ~~Standards~~

6.9.5.1 Property owners are responsible for proper operation and maintenance of their gray water irrigation systems. Gray water systems that include kitchen wastewater may have increased maintenance requirements.

6.9.5.2 All public gray water irrigation systems must submit an operation and maintenance ~~manual~~ plan to the reviewing authority in accordance with Appendix D of this Circular.

6.10 ABSORPTION BEDS

6.10.1 General

Absorption beds may be used as replacement wastewater treatment systems in existing lots where standard absorption trenches cannot be utilized. Absorption beds may be used as replacement for previously approved seepage pits. ~~when the reviewing authority has completed rewrite of the certificate of subdivision approval.~~ Absorption beds may not be used ~~to create~~ on new lots without an existing wastewater treatment system that has been in continuous use and that was permitted by the reviewing authority.

Absorption Beds must meet the same requirements as standard absorption trenches as described in Chapter 6.1, except where specifically modified in this chapter.

Rapid Infiltration Basins designed for effluent disposal rather than subsurface treatment must be designed in accordance with DEQ 2

6.10.2 Design ~~Absorption beds must meet the following design requirements.~~

6.10.2.1 Absorption beds must be more than three feet wide, and must be at least two feet in depth, unless a limiting condition requires a lesser depth, but in no case may the bed be less than one foot in depth.

6.10.2.2 Uniform pressure distribution designed in accordance with Chapter 4.3 must be provided for all absorption beds with a minimum of two distribution pipes installed per system. ~~Pressure dosing shall be in accordance with Chapter 9 and the following conditions shall also apply. A minimum of two distribution pipes shall be installed.~~

6.10.2.3 Distribution piping should be separated by a minimum of 30 inches and a maximum of 48 inches and 18 to 30 inches from the edge of the excavation.

6.10.2.4 Absorption bed sizing is determined by flows described in Chapter 3 ~~5~~, the application rates in Chapter2 ~~9~~, along with procedure of Section 6.1.4 or by using the maximum area available. Absorption beds shall not be installed with soils that have percolation rates of greater than 60 minutes per inch.

6.10.3 Construction

6.10.3.1 Absorption beds may be constructed in accordance with Chapter 2 but must not be constructed on unstabilized fill.

6.10.3.2 The excavation must be filled with a minimum of six inches of washed rock or six inches of ASTM C-33 sand

.~~Pressure dosing must be used unless another method of distribution is approved by the reviewing authority in accordance with Chapter 8. Distribution piping – pressure dosing~~

~~Uniform pressure distribution designed in accordance with Chapter 4.2 must be provided for all absorption beds with the following additional requirements:~~
~~Pressure dosing shall be in accordance with Chapter 9 and the following conditions shall also apply.~~

~~A minimum of two distribution pipes shall be installed. Distribution piping should be separated by a minimum of 30 inches and a maximum of 48 inches.~~

6.10.3.3 Distribution piping should be covered by two inches of drain rock ~~except when designed in accordance with Section 23.5.~~

6.10.3.4 Distribution piping should be installed 18 to 30 inches from the edge of the excavation.

6.10.3.5 Distribution piping ~~shall~~ must be installed to ensure uniform distribution of effluent.

6.10.3.6 Drain rock must be covered with geofabric, or, if geofabric is unavailable, a straw layer of at least four inches in depth.

6.10.3.7 Backfill for beds should be loam type soils that do not form an impervious seal. The use of high clay or silt content soils for back filling ~~should~~ must be avoided.

~~Absorption bed sizing is determined by flows in Chapter 3.1 5, the application rates in Chapter 4.2 9, or using the maximum area available. Absorption beds shall not be installed with soils that have percolation rates of greater than 60 minutes per inch.~~

6.10.4 ~~Infiltration chambers~~ Gravelless or other absorption trenches may be used in absorption beds. ~~if the entire excavation has chambers installed~~. ~~Infiltration chambers~~ or other absorption trenches must be installed in accordance with Chapter 6.5 and this chapter ~~and Chapter 13.~~ No ~~change in application rate or~~ reduction in sizing will be allowed for ~~chambers~~ the use of gravelless or other trenches in absorption beds.

7. ADVANCED WASTEWATER TREATMENT SYSTEMS

7.1 RECIRCULATING MEDIA TRICKLING FILTERS

7.1.1 General

These systems utilize aerobic, attached-growth treatment processes to biologically oxidize organic material and convert ammonia to nitrate (nitrification). A trickling filter consists of a bed of highly permeable medium to which a bio-film adheres in an unsaturated environment. Wastewater is applied to the top of the bed and trickles through the media. Microorganisms in the bio-film degrade organic material and may also nitrify the wastewater. An under-drain system collects the treated wastewater and any sloughed solids and transports it to a settling tank from which it is recirculated and trickled back through the media ~~trickling filte~~r.

Due to the reduced amount of BOD and TSS produced by this technology the absorption system used for final disposal may be reduced, except were specifically prohibited in this Circular, for the following soil types ~~downsized by 50 percent as determined by Chapter 8~~:

A. For subsurface absorption systems constructed in soils with percolation rates between 3 and 50 ~~60~~ minutes per inch as described in Chapter 2 and Appendix B, the final absorption are may be reduced by 50%;

B. For subsurface absorption systems constructed in soils with percolation rates between 51 and 120 minutes per inch as described in Chapter 2 and Appendix B, the final absorption area may be reduced by 25%.

~~The absorption system used for final disposal may be downsized by 25 percent as approved by the reviewing authority, as determined by Chapter 8.~~

The reviewing authority may request data from the recirculating trickling media filter to demonstrate performance criteria.

A separate subsurface absorption replacement area, sized without reductions, must be designated for each site using a recirculating trickling media filter.

Classification of a recirculating media trickling filter as a Level 1a, Level 1b, or Level 2 system for nutrient reduction under ARM 17.30.718 must be made under separate application. Additional design requirements may apply.

7.1.2 Design

7.1.2.1 The design criteria must include, but not necessarily be limited to, primary treatment, filter size, filter media, organic loading, hydraulic loading, dosing rate, and recirculation rate. A discussion of the treatment by the trickling filter must be provided.

7.1.2.2 Recirculating trickling filter systems must have a means of primary and secondary settling. Additional components such as pump chambers, pumps, controls, recirculation valves, etc. may be used as required.

7.1.2.3 Filter media ~~medium~~ must be resistant to spalling or flaking, and must be relatively insoluble in wastewater. The type, size, depth, volume, and clogging potential of the medium used must be based on published criteria and proven through monitoring and testing (see Section 7.1.3 ~~17.2.8~~).

7.1.2.4 The vessel containing the media must be watertight and corrosion resistant.

7.1.2.5 Waste effluent must be distributed uniformly across the design surface area of the filter.

7.1.2.6 The means of aerating the recirculation trickling filter must be described. ~~If the means of aeration does not require any mechanical equipment, the system may be considered a passive nutrient reduction system if nutrient reduction is proven through monitoring and testing. If the means of aeration requires mechanical equipment, the system may be considered a nonpassive nutrient reduction system if nutrient reduction is proven through monitoring and testing.~~

7.1.2.7 The method of recirculation and recirculation rate must be discussed and justified to show adequate functioning of the system. ~~The liquid capacity of the recirculation tank must be at least 1.5 times the daily design wastewater flow.~~ The recirculation tank must meet the same material and construction specifications as a septic tank. ~~he minimum liquid level in the recirculation tank must be at least 80 percent of the daily flow at all times during the 24-hour daily cycle.~~ The reviewing authority may require systems with large surge flows to have recirculation tanks sized based on the estimated or actual surge flow volume.

7.1.2.8 All recirculating trickling systems must operate in a manner such that if a component of the system fails and treatment diminishes or ceases, untreated effluent will not be discharged to the absorption system. Systems must be equipped with adequate alarms.

7.1.2.9 If the recirculation trickling filter system is intended to remove nitrogen, a complete description of the nitrification and denitrification processes must be provided in detail, including the unit where it occurs, carbon source, feed rates, loading rates, pumps, controls, and other mechanisms necessary.

~~The Department~~ reviewing authority ~~will consider the complexity and maintenance required of the system, the stability of the processes, and the monitoring data in determining the adequacy, level of maintenance, and monitoring frequency of the system.~~

7.1.3 A detailed set of plans and specifications and an operation and maintenance ~~manual~~ plan are required. The operation and maintenance plan must meet the requirements in Appendix D.

7.1.4 Gravelless or other ~~chambers~~ absorption trenches constructed in accordance with the requirements of Chapter 6.5 ~~13~~ may be used in lieu of a standard absorption trench. ~~No reduction in absorption system sizing will be allowed for chambers in this application.~~ The use of ~~chambers~~ gravelless trenches and other absorption systems will not qualify for ~~constitute~~ any additional reduction beyond that listed in Section 7.1.1 ~~17.1~~.

7.2 INTERMITTENT SAND FILTERS

7.2.1 General

The design criteria must include, but not necessarily be limited to, the type of usage, primary treatment, filter media, filtration rate, and dosage rate.

The wastewater strength discharged to the filter must not exceed residential strength wastewater. Intermittent sand filters must discharge to a subsurface absorption system.

Due to the reduced amount of BOD and TSS produced by intermittent sand filters, the absorption system used for final disposal may be reduced for the following soil types except were specifically addressed in this Circular:

A. For subsurface absorption systems constructed in soils with percolation rates between 3 and 50 ~~60~~ minutes per inch as described in Chapter 2 and Appendix B, the final absorption are may be reduced by 50%;

B. For subsurface absorption systems constructed in soils with percolation rates between 51 and 120 minutes per inch as described in Chapter 2 and Appendix B, the final absorption area may be reduced by 25%.

~~the absorption system used for final disposal may be downsized by 50 percent. The absorption system used for final disposal may be downsized by 50 percent, as determined by Chapter 8, for soils with percolation rates between 3 and 60 minutes per inch. The absorption system used for final disposal may be downsized by 25 percent, as determined by Chapter 8, for soils with percolation rates between 60 and 120 minutes per inch.~~
A separate subsurface absorption replacement area, sized without reductions, must be designated for each site using an intermittent sand filter.

Intermittent sand filters classified as Level 1a, Level 1b or Level 2 systems as defined in ARM 17.30.718 may have additional requirements beyond those listed in this Circular.

7.2.2 Design

7.2.2.1 The minimum area in any subsurface sand filter must be based upon a flow as determined in Chapter 3 ~~5.~~

7.2.2.2 The application rate for intermittent sand filters may not exceed ~~1.2~~ 1.0 gal/day/ft^2. This must be computed by dividing the effluent flow rate by the area (in square feet) of the filter.

7.2.2.3 A minimum of one 4 inch diameter collection line must be provided at the bottom of the intermittent sand filter. The upper end of the collection line must be provided with a 90-degree elbow turned up, a pipe to the surface of the filter, and a removable cap. The collection line may be level. The bottom of the filter may be flat or sloped to the collection line(s).

7.2.2.4 Distribution lines must be level and must be horizontally spaced a maximum of 3 feet apart, center to center. Orifices must be placed such that that there is at least one orifice for each 4 square feet of sand surface area. All intermittent sand filter dosing must be controlled by a programmable timer. The minimum depth of filter media must be 24 inches.

7.2.2.5 A watertight, 30-mil PVC liner (or equivalent) must be used to line the sand filter.

7.2.2.6 There must be a minimum of 2 inches of sand fill between the natural soil surface and/or any projecting rocks and the liner.

7.2.2.7 Washed drain rock must be placed in the bottom of the system ~~filter~~ to provide a minimum depth of 8 inches in all places and to provide a minimum of 4 inches of material over the top of the collection lines.

7.2.2.8 The drain rock must be covered with a 3-inch thick layer of ¼ inch to 1 inch washed gravel.

~~Gravel measuring ¼ inch to 1 inch must meet the following gradation:~~

~~**Sieve**~~	~~**Particle Size (mm)**~~	~~**Percent Passing**~~
~~1 inch~~	~~25~~	~~100~~
~~¾ inch~~	~~19~~	~~50 to 100~~
~~3/8 inch~~	~~9.5~~	~~30 to 80~~
~~No.4~~	~~4.75~~	~~0 to 20~~
~~No. 8~~	~~2.36~~	~~0 to 2~~
~~No. 16~~	~~1.18~~	~~0 to 1~~

~~Drain rock must meet the requirements for a standard absorption system, except it must be a minimum of 1 inch in diameter to prevent clogging.~~

7.2.2.9 A minimum of 24 inches of filter sand media must be placed above the ¼ inch to 1 inch washed gravel.

7.2.2.10 A layer of ¼-inch to 1-inch washed gravel must be placed over the sand media, with at least 3 inches placed over the distribution lines and 3 inches placed under the distribution lines .The distribution pipes must be installed in the center of this layer, and all parts of the distribution system must drain between cycles.

7.2.2.11 A synthetic drainage fabric must be used to separate the top layer of washed gravel containing the distribution lines and the sand media to keep silt from moving into the sand while allowing air and water to pass through. ~~The material used to cover the top of the sand filter must be separated from the filter by a synthetic drainage fabric.~~

7.2.2.12 The intermittent sand filter must be backfilled with ~~covered with~~ 6 inches (at the edges) to 8 inches (at the center) of a suitable medium, such as sandy loam or loamy sand that is then planted with sod or other shallow rooted vegetative cover. ~~to provide drainage and aeration. The material must be seeded, sodded, or otherwise provided with shallow-rooted vegetative cover to ensure stability of the installation.~~

7.2.2.13 Monitoring pipes to detect filter clogging must be installed. A means for sampling effluent quality must be provided.

7.2.3 Uniform pressure distribution designed in accordance with Chapter 4.3 must be provided for all sand filters ~~Uniform pressure distribution must be provided for all sand filters in accordance with Chapter 9~~ except for Section 4.2.3 ~~9.3~~.

7.2.4 The dose volume must not exceed 0.25 gallons per dose per orifice. The dose frequency must not exceed 1 dose per hour per zone. The dose tank must include a minimum surge volume of one-half the daily flow for individual or shared systems. For multiple-user and public systems, the applicant must demonstrate that a smaller surge volume is adequate. The surge volume is the liquid storage capacity between the "timer-on" float and the "timer-override" float. The "timer-override" float and the "high-water alarm" float may be combined. Note that the surge volume defined here is not the same as the reserve storage volume defined in Chapter 4 ~~9~~.

7.2.5 Materials

7.2.5.1 Washed drain rock must be a minimum of 1 inch in diameter to prevent clogging.

7.2.5.2 Washed gravel measuring ¼ inch to 3/4 ~~1~~ inch in diameter must meet the following gradation:

Sieve	**Particle Size (mm)**	**Percent Passing**
1 inch	25	100
¾ inch	19	50 to 100
3/8 inch	9.5	30 to 80
No.4	4.75	0 to 10 ~~20~~
No. 8	2.36	0 to 2
No. 16	1.18	0 to 1

7.2.5.3 The filter media must be washed and free of clay or silt and contain the following criteria in place:

Sieve	**Particle Size (mm)**	**Percent Passing**

3/8 in	9.50	100
No. 4	4.75	95 to 100
No. 8	2.36	80 to 100
No. 16	1.18	45 to 85
No. 30	0.60	15 to 60
No. 50	0.30	3 to 10
No. 100	0.15	0 to 2

7.2.5.4 The intermittent sand filter must be covered by a suitable medium, such as sandy loam or loamy sand, to provide drainage and aeration. The material must be seeded, sodded, or otherwise provided with shallow-rooted vegetative cover to ensure stability of the installation.

~~If the system is intended to remove nitrogen, a complete description of the nitrification and dentrification processes must be provided in detail, including the unit where it occurs, carbon source, feed rates, loading rates, pumps, controls, and other mechanisms necessary~~.

7.2.6 A detailed set of plans and specifications and an operation and maintenance ~~manual~~ plan are required. The operation and maintenance plan must meet the requirements in Appendix D.

7.2.7 Gravelless trenches and other absorption systems ~~chambers~~ constructed in accordance with the requirements of Chapter 6.5 ~~13~~ may be used in lieu of a standard absorption trench. The use of gravelless trenches and other absorption systems will not qualify for any additional reduction beyond that listed in 7.2.1.~~No reduction in absorption system sizing will be allowed for chambers in this application. The use of chambers will not constitute any additional reduction beyond that listed in 15.1~~

7.3 RECIRCULATING SAND FILTERS

7.3.1 General

The design criteria must include, but not necessarily be limited to, the type of usage, primary treatment, filter media, filtration rate, and dosage rate. The wastewater strength discharged to the sand filter must not exceed residential strength wastewater. Recirculating sand filters must discharge to a subsurface absorption system

Due to the reduced amount of BOD and TSS produced by recirculating sand filters, the absorption system used for final disposal may be reduced for the following soil types except were specifically addressed in this Circular:

A. For subsurface absorption systems constructed in soils with percolation rates between 3 and 50 ~~60~~ minutes per inch as described in Chapter 2 and Appendix B, the final absorption are may be reduced by 50%;

B. For subsurface absorption systems constructed in soils with percolation rates between 51 and 120 minutes per inch as described in Chapter 2 and Appendix B, the final absorption area may be reduced by 25%.

~~The absorption system used for final disposal may be downsized ; the absorption system used for final disposal may be downsized by 50 percent. The absorption system used for final disposal may be downsized by 50 percent, as determined by Chapter 8, for soils with percolation rates between 3 and 60 minutes per inch. The absorption system used for final disposal may be downsized by 25 percent, as determined by Chapter 8, for soils with percolation rates between 60 and 120 minutes per inch.~~

A separate subsurface absorption replacement area, sized without reductions, must be designated for each site using a recirculating sand filter.

Recirculating sand filters classified as Level 1a, Level 1b or Level 2 systems as defined in ARM 17.30.718 may have additional requirements beyond those listed in this Circular.

7.3.2 Design

7.3.2.1 A watertight, 30-mil PVC liner (or equivalent) must be used to line the sand filter. There must be a minimum of 2 inches of sand fill between the soil surface and/or any projecting rocks and the liner.

7.3.2.2 Entrance and exit points resulting in liner penetration must be water tight.

7.3.2.3 Drain rock must be placed in the bottom of the filter, providing a minimum depth of 6 inches in all places and providing a minimum of 2 inches of material over the top of the collection lines. The drain rock must be covered with a 3-inch layer of 1/4-inch to 3/4 ~~1~~-inch washed gravel meeting the gradation chart in 7.2.5.2. ~~15.2.5~~.

Drain rock for the under-drain lines must meet the requirements for a standard absorption system, except it must be a minimum of 1~~’’~~ inch in diameter to prevent clogging. ~~The drain rock at the bottom may be replaced with 1/8-inch to 3/8-inch washed gravel, except for 6 inches around the collection pipe.~~

7.3.2.4 The depth of filter media must be at least 24 inches. ~~The media must be washed, have a maximum particle size of 3/8 inch, and an effective size between 1.5 and 2.5 mm with and a Uniformity Coefficient of 2 or less, with less than 2 percent passing No. 30 sieve and less than 2 percent passing No. 50 sieve. , Filter media measuring 1/8-inch to 3/8-inches in size~~ The media must have a Uniformity Coefficient of 2 or less, must be washed, and must meet the following gradation:

Sieve	**Particle Size (mm)**	**Percent Passing**
1/2 in	12.5	100
3/8 in	9.50	50 to 95 ~~95 to 100~~
No. 4	4.75	0 to 15 ~~30~~
No. 8	2.36	0 to 1.6 ~~15~~
~~No. 100~~	~~0.15~~	~~0 to 2~~

7.3.2.5 The filter media must be covered with a layer of 3/4 ~~¼~~-inch to 1½-inch washed gravel at least 6 inches thick. The distribution pipes must be installed in the center of this layer, and all parts of the distribution system must drain between cycles.

7.3.2.6 For sizing the filter, the application rate must not exceed 5 gallons per day per square foot of filter area. This must be computed by dividing the effluent flow rate (not considering the amount of recirculation) by the area (in square feet) of the filter.

7.3.2.7 The liquid capacity of the recirculation tank must be at least 1.5 times the daily design wastewater flow. The recirculation tank must meet the same material and construction specifications as a septic tank. The minimum liquid level in the recirculation tank must be at least 80 percent of the daily flow at all times during the 24-hour daily cycle. The reviewing authority may require systems with large surge flows to have recirculation tanks sized based on the estimated or actual surge flow volume.

7.3.2.8 The filter-effluent line passing through the recirculation tank must be provided with a control device that directs the flow of the filter effluent. The filter effluent will be returned to the recirculation tank for recycling or be discharged to the subsurface absorption system, depending upon the liquid level in the recirculation tank. The recirculation pump(s) must be located at the opposite end of the recirculation tank from the filter return line and the tank inlet(s).

7.3.2.9 The system must be designed with a minimum recirculation ratio of not less than four. Each orifice must be dosed at least every 30 minutes, and the maximum dose volume must be 2 gallons per orifice per dose. All recirculating sand-filter dosing must be controlled with a programmable timer.

7.3.2.10 A minimum of one 4 inch diameter collection line must be provided. The upper end of the collection line must be provided with a sweep to the surface which includes a 90-degree elbow turned up, a pipe to the surface of the filter, and a removable cap. The collection line may be flat. The bottom of the filter may be flat or sloped to the collection line(s)

7.3.2.11 Distribution lines must be level and must be horizontally spaced a maximum of 3 feet apart, center to center. Orifices must be placed such that there is at least one orifice for each 4 square feet of filter media surface area.

7.3.2.12 The effluent must be discharged in such a manner as to provide uniform distribution in accordance with Chapter 4.3 ~~9~~ except for Section 4.2.2.B.v ~~9.3~~.

7.3.2.13 The distribution line must be designed for freezing conditions. ~~to be protected from freezing~~. The plans and engineering report will specify how this is accomplished.

7.3.2.14 Topsoil or other oxygen limiting materials must not be placed over the filter.

7.3.2.15 ~~If the recirculation sand filter system is intended to remove nitrogen, a complete description of the nitrification and denitrification processes must be provided in detail, including the unit where it occurs, carbon source, feed rates, loading rates, pumps, controls, and other mechanisms necessary.~~

7.3.3 A detailed set of plans and specifications and an operation and maintenance ~~manual~~ plan are required. The operation and maintenance plan must meet the requirements in Appendix D.

7.3.4 Gravelless trenches and other absorption systems ~~chambers~~ constructed in accordance with the requirements of Chapter 6.5 ~~13~~ may be used in lieu of a standard absorption trench. The use of ~~chambers~~ gravelless trenches and other absorption systems will not qualify for any additional reduction beyond that listed in 7.3.1.~~No reduction in absorption system sizing will be allowed for chambers in this application. The use of chambers will not constitute any additional reduction beyond that listed in 16.1~~

7.4 AEROBIC WASTEWATER TREATMENT UNITS

7.4.1 General

Aerobic treatment units (ATUs) are concrete tanks or other containers of various configurations that provide for aerobic biodegradation or decomposition of the wastewater components in a saturated environment by bringing the wastewater in contact with air by some mechanical means. ATUs are exclusively proprietary products representing a wide variety of designs, materials, and methods of assembly.

Classification of ATUs as Level 1a, Level 1b, or Level 2 systems for nutrient reduction under ARM 17.30.718 must be made under separate application.

All ATUs must discharge to a subsurface wastewater treatment system. This treatment system must be sized in accordance with Chapters 2, and 3, and Section 6.1.4. Aerobic treatment devices must demonstrate compliance with the testing criteria and performance requirements for NSF Standard No. 40 for Class 1 certification. This compliance may be demonstrated either through NSF, through a third independent party using comparable protocol or through the testing requirements outlined in ARM 17.30.718 for 30 mg/L BOD and 30 mg/L TSS only. ATUs may apply the following sizing reduction to the subsurface absorption area:

A. For subsurface absorption systems constructed in soils with percolation rates between 3 and 50 ~~60~~ minutes per inch as described in Chapter 2 and Appendix B, the final absorption are may be reduced by 50%;

B. For subsurface absorption systems constructed in soils with percolation rates between 51 and 120 minutes per inch as described in Chapter 2 and Appendix B, the final absorption area may be reduced by 25%.

A separate subsurface absorption replacement area, sized without reductions, must be designated for each site using an ATU.

~~A means of securing continuous operation and maintenance of these systems (such as a county sewer district) must be approved by the county health department prior to Department approval. ATU systems must be recorded on the property Deed of Trust.~~

~~Types of devices/systems~~

~~For the purposes of this Circular, there are two types of aerobic devices or systems:~~

~~A. Type 1 - Those devices or systems designed to treat residential strength wastewater.~~

~~B.~~ Type 2 ~~- Those devices or systems designed to treat high-strength wastewater to at least residential strength wastewater.~~

~~Design of the Individual Treatment Device~~

~~ATUs are exclusively proprietary products representing a wide variety of designs, materials, and methods of assembly~~

~~The individual treatment device must have been tested by a laboratory independent from the manufacturer of that device.~~

~~A. For Type 1, aerobic treatment devices (those designed to treat residential strength wastewater), the testing criteria and performance must be at least equal to that specified and required in NSF Standard No. 40 for Class 1 certification.~~

~~B. For Type 2, aerobic treatment devices (those designed to treat high-strength wastewater to at least residential strength wastewater), the testing criteria must at least be equal to that specified and required in NSF Standard No. 40, with a stress testing regime designed to evaluate the device under adverse conditions consistent with those anticipated for the specific wastewater treatment application(s). Device treatment performance must be at least equal to residential strength wastewater.~~

7.4.2 An adequate form of positive filtration will be required between the treatment device and the disposal component to prevent excessive solids from being carried over into the disposal component during periods of bulking.

7.4.3 ~~Primary Treatment~~ ATU systems must provide primary treatment for wastewater through a septic tank that meets all of the requirements of Chapter 5. Designs for the use of an external trash rack will be evaluated on a case by case basis.

~~20.3.4.1 For those ATUs using an external trash tank or septic tank (single or multiple compartment) to pretreat wastewater during performance testing:~~

~~A. A tank of at least equivalent design and volume capacity is required as a component of the wastewater system.~~

~~B. A conventional two-compartment tank may be used in the place of a single compartment tank, if consistent with the manufacturer's recommendations.~~

~~20.3.4.2 For those ATUs not using an external trash tank or septic tank to pretreat wastewater, primary treatment must be provided.~~

~~Advanced treatment (level 2)~~

~~Unless otherwise addressed by rule for level 2 treatment, If the aerobic treatment unit is intended to attain a higher level of treatment than a septic tank, monitoring data must be submitted~~ . ~~from at least three existing systems operating in similar climates and treating wastewater similar in characteristics~~. ~~to that to be treated. Monitoring must include at least six cumulative years of data, with one system being in operation at least three years. Minimum data submitted must include information on time to reach steady state conditions, required maintenance and operation, average daily flow, and influent values for each parameter (if other than residential strength wastewater), and effluent values for each parameter. Sample analysis is to be done by an independent laboratory.~~

~~20.3.4.1 If the system is intended to remove nitrogen, a complete description of the nitrification and denitrification processes must be provided in detail, including the unit where it occurs, carbon source, feed rates, loading rates, pumps, controls, and other mechanisms necessary.~~

~~20.3.4.2 The monitoring frequency must be sufficient to establish the treatment efficiency and response to varying wastewater flows, strengths, and climatic condition.~~

~~20.3.4.3 The Department reviewing authority will consider the complexity and maintenance required of the system, the stability of the processes, and the monitoring data in determining the adequacy, level of maintenance, and monitoring frequency of the system.~~

7.4.4 Access ports

7.4.4.1 Ground level access ports must be sized and located to facilitate installation, removal, sampling, examination, maintenance, and servicing of components or compartments that require routine maintenance or inspection.

7.4.4.2 Access ports must be protected against unauthorized intrusion. Acceptable protective measures include, but are not limited to, padlocks or covers that can be removed only with tools.

7.4.5 Failure sensing and signaling equipment

7.4.5.1 The ATU must possess a mechanism or process capable of detecting:

A. failure of electrical and mechanical components that are critical to the treatment process; and,

B. high liquid level conditions above the normal operation specifications.

7.4.5.2 The ATU must possess a mechanism or process capable of notifying the system owner of failure identified by the failure sensing components. The mechanism must deliver a visible and audible signal.

7.4.6 Installation

ATUs must be installed according to the manufacturer's instructions in compliance with state and local rules, and by an authorized representative of the manufacturer and an installer who is approved by the reviewing authority.

7.4.7 Sampling ports

7.4.7.1 A sampling port must be designed, constructed, and installed to provide easy access for collecting a water sample from the effluent stream. The sampling port may be located within the ATU or other system component (such as a pump chamber) provided that the wastewater stream being sampled is representative of the effluent stream from the ATU.

~~For ATUs using effluent disinfection to meet the fecal coliform criteria, the sampling port must be located downstream of the disinfection component (including the contact chamber if chemical disinfection is used) so that samples will accurately reflect disinfection performance.~~

7.4.7.2 Sampling ports must be protected against unauthorized intrusion, as described in 7.4.6. ~~20.4.2~~.

~~Design of the disposal component~~

~~20.8.1 If using soil absorption for disposal, the size of the effluent absorption area must be the same as for a standard absorption trench system. . No reduction in absorption system area may be allowed. If monitoring data is collected as required in 20.3.4, and that data clearly indicates the following effluent quality parameters are met, the absorption system size may be reduced by 50 percent:~~

~~BOD_5 – 30-day average of less than 10 mg/L~~
~~TSS – 30-day average of less than 10 mg/L~~
~~Fecal coliform – 30-day geometric mean less than 800 coliform/100 ml~~

~~If an absorption system size reduction is allowed, adequate space must still be provided for an absorption area (and replacement area) large enough for a standard absorption trench system.~~

7.4.8 A detailed set of plans and specifications and an operation and maintenance ~~manual~~ plan are required. The operation and maintenance plan must meet the requirements outlined in Appendix D.

~~20.9.1 Service-related obligations~~

~~20.9.1.1 In the event that a mechanical or electrical component of the ATU requires off-site repair, the local authorized representative must maintain a stock of mechanical and electrical components that can be temporarily~~

~~installed until repairs are completed if repairs are expected to render the unit inoperable for longer than 24 hours.~~

~~20.9.1.2 Emergency service must be available within 48 hours of a service request.~~

~~20.9.1.3 The ATU service provider must possess adequate knowledge and skill regarding on-site wastewater treatment, effluent disposal concepts, and system function. The service provider must be:~~

~~A. Product-certified by each manufacturer for any ATUs they intend to serve,~~

~~B. Able to provide documentation of product certification as evidence upon request, and~~

~~C. Able to demonstrate competency in the servicing (O & M) of on-site wastewater systems.~~

~~20.9.1.4 O & M service contracts establish the initial and on-going relationship between the O & M service provider and system owner. The service provider may be the ATU manufacturer/service representative of the system owner. The contract must identify the roles and responsibilities assigned to the service provider. The specifics of O & M service contracts may vary product-to-product and locality-to-locality, but all O & M service contracts must include information/conditions of agreement such as:~~

~~A. Owner's name and address;~~

~~B. Property address and legal description;~~

~~C. Local health department permit requirements;~~

~~D. Specific contracts/owner address, service provider, and local health department;~~

~~E. Detail of service to be provided;~~

~~F. Schedule of service provider duties;~~

~~G. Cost and length of service contract/time period;~~

~~H. Details of product warranty;~~

~~I. Owner's responsibilities under the contract and routine operation of the wastewater treatment and disposal system;~~

~~J. Document recording, such as notification to the mortgage-holder or attachment to the deed of trust.~~

~~20.9.1.5 O & M service record keeping and reports required for the local health jurisdiction must specify:~~

~~A. What data is to be reported,~~

~~B. To whom the reports are to be submitted,~~

~~C. The format for presenting information, and~~

~~D. The frequency of reporting.~~

7.5 CHEMICAL NUTRIENT-REDUCTION SYSTEMS

7.5.1 General

A means of securing continuous maintenance and operation of the system must be approved by the reviewing authority.

7.5.2 Design

Specific design criteria will not be outlined in this document due to the various alternatives and design complexity involved. The EPA manual, *On-Site Wastewater Treatment Systems Manual* (February 2002), pages TFS-41 to 52, will be used as a guideline for the design of these systems.

7.5.3 Maintenance and Operation

A detailed set of plans and specifications and an operation and maintenance ~~manual~~ plan are required. The operation and maintenance plan must meet the requirements outlined in Appendix D.

7.6 ALTERNATE ADVANCED TREATMENT SYSTEMS

7.6.1 General

Alternative advanced treatment systems will be evaluated by the reviewing authority on a case-by-case basis.

7.6.2 Design

Specific design criteria will not be outlined in this document due to the various alternatives and design complexity involved.

Those systems that provide documentation or demonstrate through a third independent party that the unit is able to meet the testing criteria and performance requirements for NSF Standard No. 40 for Class 1 certification or meet the testing requirements outlined in ARM 17.30.718 for 30 mg/L BOD and 30 mg/L TSS, testing for other continuants is not required, may apply the following sizing reduction to the subsurface absorption area:

A. For subsurface absorption systems constructed in soils with percolation rates between 3 and 50 ~~60~~ minutes per inch as described in Chapter 2 and Appendix B, the final absorption are may be reduced by 50%;

B. For subsurface absorption systems constructed in soils with percolation rates between 51 and 120 minutes per inch as described in Chapter 2 and Appendix B, the final absorption area may be reduced by 25%.

A separate subsurface absorption replacement area, sized without reductions, must be designated for each site using an Alternative Advanced Treatment System.

7.6.3 Maintenance and Operation

A detailed set of plans and specifications and an operation and maintenance plan are required. The operation and maintenance plan must meet the requirements outlined in Appendix D.

8. MISCELLANEOUS

8.1 HOLDING TANKS

8.1.1 General

Holding tanks are used to hold wastewater until pumping occurs by a licensed septic tank pumping service and wastewater is disposed at an approved location. They are used for retention and do not as part of their normal operation dispose of or treat the wastewater**.**

8.1.2 Holding tanks are septic tanks that have no standard outlets and are modified to provide full time access for pumping.

8.1.3 Holding tanks must have a minimum capacity of 1000 gallons. Larger tank capacity may be required by the reviewing authority. ~~as determined on a case by case basis~~.

8.1.4 Holding tanks must meet the construction standards for septic tanks ~~of~~ Chapter 5~~7~~ except that no outlet opening shall be cast in the tank walls~~. Holding tanks installed where the seasonal groundwater table may reach any portion of the tank must be a single pour (seamless) tank design.~~

8.1.5 Holding tanks must have an audible or visual warning alarm that signals when the tank level has reached 75 percent of capacity. The tank must be pumped as soon as possible after the alarm is triggered and before the tank reaches 100 percent capacity.

8.1.6 Holding tanks installed where the seasonal groundwater table may reach any portion of the tank must be a single pour (seamless) tank design, must be waterproofed against infiltration, and must be stabilized against flotation. ~~if the tank is installed where seasonal groundwater may reach any portion of the tank.~~

~~Holding tanks must be waterproofed against infiltration and exfiltration~~.

8.1.7 Holding tanks must meet the separation distances and other applicable requirements in the subdivision and county minimum standard regulations, ARM Title 17, Chapter 36, subchapters 3 or 9. ~~17.36.101 through 1107.~~

8.2 SEALED (VAULT) PIT PRIVY

8.2.1 General

A sealed pit privy is an underground vault for the temporary storage of non-water-carried wastewater. The vault must be pumped periodically and the wastewater disposed at a ~~secondary~~ treatment site.

8.2.2 Construction

8.2.2.1 The vault must be watertight, constructed of durable material and not subject to excessive corrosion, decay, frost damage or cracking.

8.2.2.2 The vault may be used in a floodplain or high groundwater area at public recreational facilities operated by governmental institutions provided that the floor surface is one foot above the floodplain elevation and the weight of the structure is adequate to prevent the vault from floating during high groundwater or a flood even when the vault is empty.

8.2.2.3 The access or pumping port should be located outside of any structure and should have a minimum diameter of 8 inches. This access must have a tight, locking lid.

8.2.2.4 The vault may be a modified septic tank with the inlet and outlet opening sealed. The toilet structure over the tank vault must meet construction standards for a pit privy.

8.2.3 Maintenance <u>and Operation</u>

The vault must be pumped ~~as needed~~ prior to reaching the maximum capacity of the tank, by a licensed septic tank pumper <u>and wastewater is disposed of at an approved location</u>.

8.3 UNSEALED PIT PRIVY

8.3.1 General

A pit privy is a building containing a stool, urinal or seat over an excavation in natural soil for the disposal of undiluted black wastes (toilet wastes). Pit privies ~~shall~~ may only serve structures that have no pumping fixtures or running water (piped water supply). Pit privies ~~are framed structures used for disposal of wastewater and~~ must meet the location requirements of ARM Title 17 Chapter 36 Subchapters 3 or 9. ~~black wastes (toilet wastes) that meet setback distances of standard absorption trench excavations.~~

8.3.2 Construction

8.3.2.1 Pit privies ~~shall~~ must be located to exclude surface water.

8.3.2.2 Pit privy buildings must be constructed with openings no greater than 1/16 inch to prohibit access to insects ~~with openings no greater than 1/16 inch~~.

8.3.2.3 The pit must be vented with a screened flue or vent stack having a cross sectional area of at least 7 inches per seat and extending at least 12 inches above the roof of the building.

8.3.2.4 The pit privy must be constructed on a level site with the base of the building being at least 6 inches above the natural ground surface as measured 18 inches from the sides of the building.

8.3.2.5 The bottom of the pit should be between three feet ~~(3' feet)~~ and six feet ~~(6' feet)~~ below the original ground surface.

8.3.3 Abandoning Pit Privies

8.3.3.1 A pit privy should be abandoned when the waste comes within 16 inches of the ground surface.

8.3.3.2 A pit privy building should be either dismantled or moved to cover a new pit.

8.3.3.3 The pit ~~shall~~ must be filled with soil, free of rock, with sufficient fill material to allow for 12 inches or more of settling. The site ~~shall~~ must be marked.

8.4 SEEPAGE PITS

8.4.1 General

Seepage pits may be used for replacement systems only ~~and may not be constructed in unstabilized fill.~~ Seepage pits are excavations in which a subsurface concrete ring(s) is placed in drain rock ~~is placed and filled around the concrete ring with drain rock~~ to receive effluent from the septic tank.

8.4.2 Design

8.4.2.1 Seepage pits ~~shall~~ must be sized according to the permeability of the vertical stratum where wastewater will contact the soils.

8.4.2.2 A seepage pit that is excavated to a four-foot depth and a five-foot diameter s~~hall~~ must be equivalent to 50 square feet of absorption area.

8.4.2.3 A seepage pit ~~shall~~ must have a concrete ring with a minimum diameter of three feet and a minimum height of 3.5 feet. Concrete rings ~~can~~ may be stacked to provide for additional absorption area.

8.4.2.4 The seepage pit s~~hall~~ must have six inches of drain rock placed in the bottom of the excavation for bedding.

8.4.2.5 The concrete ring ~~shall~~ must have a minimum of one foot of drain rock placed on the outside of the ring. A concrete lid shall be installed on each concrete ring or on the top-most concrete ring if stacked.

8.4.2.6 Schedule 40 piping, or equivalent strength, ~~shall~~ must be used to connect the septic tank or the distribution box to the concrete ring(s).

8.4.2.7 Drain rock must be covered with geofabric or synthetic drainage fabric, or if geofabric is unavailable, a straw layer of at least five inches in depth.

8.4.2.8 Effluent distribution to multiple seepage pits ~~shall~~ must use a distribution box.

8.4.2.9 Seepage pits ~~shall~~ must not be installed in soils that have percolation rates greater than 60 minutes per inch.

8.5 WASTE SEGREGATION

8.5.1 General

Waste segregation systems consist of dry disposal for human waste, such as various biological or composting and incinerator type systems, with separate disposal for gray water.

8.5.2 A complete layout must be provided showing the location of the absorption system and 100 percent replacement site or an alternate approved wastewater treatment system for future development needs.

8.5.3 Design

This Circular addresses the specific requirements relating to the use of composting and incinerating toilets. The reviewing authority may allow the use of other designs and materials pursuant to the review of manufacturer's information and data to substantiate the proposed alternative.

8.5.3.1 Composting Toilets

A. Composting toilets must either provide documentation or demonstrate through a third independent party that the unit is able to meet the testing criteria and performance requirements for NSF Standard 41.

B. All materials used must be durable, easily cleanable, and impervious to strong acid or alkaline solutions and corrosive environments.

C. Composting toilets must be used in accordance with the manufacturer's recommendation to serve the anticipated number of persons.

D. The composting unit must be constructed to separate the solid fraction from the liquid fraction and produce a stable humus material with less than 200 MPN per gram of fecal coliform.

E. Bulking agents may be added to provide spaces for aeration and microbial colonization.

F. All electrical work, materials, and equipment must comply with applicable provisions of the National Electrical Manufacturers' Association (NEMA), the National Electric Code, and local electrical codes.

G. When operated at the design rated capacity, the device must be capable of accommodating full or part-time usage.

H. Continuous forced ventilation to the outside (e.g. electric fan or wind-driven turbo vent) of the storage or treatment chamber must be provided to the outside. Ventilation components must be independent of other household venting systems. Venting connections must not be made to room vents or to chimneys. All vents must be designed to prevent flies and other insects from entering the treatment chamber. Vent conduits and pipes must be adequately insulated to prevent the formation of interior condensed vapors.

I. Components in which biological activity is intended to occur must be insulated, heated, or otherwise protected from low temperature conditions. In order to maintain the stored wastes at temperatures conducive to aerobic biological decomposition it is recommended that the components maintain a temperature range of 20° C - 55° C (68° F - 130° F). The device must be capable of maintaining wastes within a moisture range of 40% to 75%.

J. The device must be designed to prevent the deposition of inadequately treated waste near the clean out port. The solid end product (i.e. waste humus) must be stabilized to meet NSF (National Sanitation Foundation) criteria prior to removal at the clean-out port.

K. Any liquid overflow must be discharged to a disposal field designed and approved in accordance with this Circular.

L. The contents of a composting toilet shall be removed and disposed of in compliance with 40 CFR Part 503 and ARM Title 75 Chapter 10.

M. The owner of composting toilet shall maintain the waste disposal system.

8.5.3.2 Incinerating Toilets

A. Incinerating toilets may be electric or gas-fired.

B. Incinerating toilets must either provide documentation or demonstrate through a third independent party that the unit is able to meet the testing criteria and performance requirements for NSF Standard 41.

C. Incinerating toilets must be used in accordance with the manufacturer's recommendation to serve the anticipated number of persons.

D. All electrical work, materials, and equipment must comply with applicable provisions of the National Electrical Manufacturers' Association (NEMA), the National Electric Code, and local electrical codes.

E. All gas fired incinerating toilets must be plumbed and installed as per manufactures recommendation and local requirements.

F. An anti-foaming agent may be added to incinerating toilets to prevent boil-over of liquid waste.

G. When operated at the design rated capacity, the device must be capable of accommodating full or part-time usage.

H. The contents of an incinerating toilet must be removed and disposed of in compliance with 40 CFR Part 503 and Title 75 Chapter 10, Part 2 MCA.

I. Vapor and products of combustion must be vented. Ventilation components must be independent of other household venting systems.

J. Incinerating toilets must be installed and operated in accordance with local air pollution requirements.

K. The owner of an incinerating toilet shall maintain the waste disposal system.

8.6 EXPERIMENTAL SYSTEMS

8.6.1 General

Treatment systems not listed in this Circular may receive a waiver for use as experimental systems. Experimental systems ~~must only~~ may be considered only under the following conditions:

8.6.1.1 The applicant ~~must~~ shall provide adequate information to the reviewing authority that ensures the system will effectively treat the wastewater in a manner that will prevent ground water contamination and will meet all of the requirements of ARM Title 17, Chapter 36, subchapter 9~~. Failure to meet the requirements of ARM Title 17, chapter 36, subchapter 9 or any waiver, deviation, or variance conditions shall invalidate the approval and be grounds to order cessation of use of the system and buildings that the system serves.~~

8.6.1.2 The applicant ~~must~~ shall include a complete description of a scientific evaluation process to be carried out by a scientific, educational, governmental, or engineering organization.

8.6.1.3 The applicant ~~must~~ shall provide for any funding necessary to provide adequate design, installation, monitoring, and maintenance.

8.6.1.4 A professional engineer, sanitarian, or other professional acceptable to the reviewing authority shall design the system. ~~The system must be designed by a professional engineer, sanitarian, or other professional acceptable to the reviewing authority.~~

8.6.2 The reviewing authority may place any requirements or restriction it deems necessary on an experimental system. All requirements for conventional systems must apply to experimental systems except those specifically exempted by ~~the~~ waiver. ~~An approval to construct an experimental system is not transferable from person to person.~~ Applicants ~~must~~ shall provide for inspections to be made by persons acceptable to the reviewing authority. Monitoring and inspections must be conducted as required by the reviewing authority. The monitoring and inspection results must be submitted to the reviewing authority. The reviewing authority may require that a redundant system (i.e., a system that meets the requirements of another chapter of this Circular) be installed in parallel with the experimental system.

8.6.3 Any person who sells a property containing an experimental system ~~must~~ shall disclose all permit, monitoring, and maintenance requirements to the buyer.

8.6.4 Maintenance and Operation

8.6.4.1 Continuous maintenance and operation must be provided for the life of the system by a management entity acceptable to the reviewing authority. The type of entity required and the degree of management ~~will~~ must be commensurate with the complexity of the system and the site conditions.

8.6.4.2 The management entity ~~must~~ shall be responsible for monitoring the operation of the system.

8.6.4.3 Frequent inspections (as determined by the reviewing authority) of the mechanical equipment must be provided during the first 90-day start-up period.

8.6.4.4 The routine inspection schedule must be quarterly at a minimum.

8.6.4.5 Records, both of maintenance and performance, must be kept and made available to the reviewing authority upon request. ~~submitted annually to the reviewing authority department.~~

8.6.4.6 All manufacturers of experimental systems ~~must~~ shall provide a ~~maintenance and~~ operation and maintenance plan in accordance with Appendix D. ~~which must be followed. The manual must~~ also ~~contain detailed instructions on proper operation and maintenance procedures, including safety, a replacement parts list, public health considerations, limitations of the unit, detection of a malfunction, and expectations from a well functioning unit.~~

~~Notification to the service provider and the local health department must be made within two business days if, for some reason, a unit fails to function properly.~~

8.6.5 ~~Advance treatment~~

8.6.5.1 ~~Unless otherwise addressed by rule for level 2 treatment, If the experimental system is intended to attain a higher level of treatment than a septic tank, monitoring data must be submitted from at least three existing systems operation in similar climates and treating wastewater similar in characteristics to that to be treated. Monitoring must include a least six cumulative years of data, with one system being in operation at least three years. Minimum data submitted must include information on time to reach steady-state conditions, required maintenance and operation, average daily flow, and influent and effluent values for each parameter. Sample analysis is to be done by an independent laboratory.~~

~~22.5.1 The monitoring frequency must be sufficient to establish the treatment efficiency and response to varying wastewater flows, strengths, and climatic conditions.~~

~~22.5.2 The Department will consider the complexity and maintenance required of the system, the stability of the processes, and the monitoring data in determining the adequacy, level of maintenance, and monitoring frequency of the system.~~

APPENDIX A- PERCOLATION TEST PROCEDURE

Properly conducted percolation tests are needed to determine absorption system site suitability and to size the absorption system. Percolation tests must be conducted within the boundary of the proposed absorption system. The percolation test must be completed by an individual approved by the reviewing authority.

Test hole preparation

1. Dig or bore holes 6 to 8 inches in diameter, with a maximum size of 10 inches, with vertical sides. The depth of the holes must be at the approximate depth of the proposed absorption trenches, typically 24 inches below ground. If hole is larger than 6 to 8 inches, place a piece of 4-inch diameter, perforated pipe inside the hole, and fill the space between the pipe and the walls of the hole with drain rock.

2. Roughen or scratch the bottoms and sides of the holes to provide natural unsmeared surfaces. Remove loose material. Place about 2 inches of ¾-inch washed gravel in the bottom of holes to prevent scouring during water addition.

3. Establish a reference point for measurements in or above each hole.

Soaking

1. Fill holes with clear water to a level at least 12 inches above the gravel.

2. If the soil is coarser than sandy clay loam and the first 12 inches of water seeps away in 60 minutes or less, add 12 inches of water a second time. If the second filling seeps away in 60 minutes or less, the percolation test should be run in accordance with the sandy soil test; proceed immediately with that test. If both the first and second fillings have percolation rates faster than 3 minutes per inch, and the test may be stopped.

3. If either the soil is sandy clay loam or finer; or the first 12 inches or the second 12 inches does not seep away in 60 minutes, the percolation test must be run in accordance with the test for other soils. In these other soils, maintain at least 12 inches of water in the hole for at least 4 hours to presoak the hole.

Test

1. This test is applicable to sandy soils only (percolation rate of 10 minutes per inch or faster)

   Add water to provide a depth of 6 inches above gravel. Measure water level drop at least four times, in equally spaced intervals, in a 1 hour time period. Measure to nearest ¼ inch. Refill to 6-inch depth after each measurement. Do not exceed 6-inch depth of water. Use final water-level drop to calculate rate.

2. Other soils (percolation rate slower than 10 minutes per inch).

Remove loose material on top of gravel. Add water to provide a depth of 6 inches above gravel. Measure water levels for a minimum of 1 hour. A minimum of four measurements must be taken. The test must continue until two successive readings yield percolation rates that do not vary by more than 15 percent, or until measurements have been taken for four hours. Do not exceed 6-inch depth of water. Use final water-level drop to calculate rate.

Records

Record the following information on the attached form, and include as part of the application:

- Date(s) of test(s),
- Location, diameter, and depth of each test hole,
- Time of day that each soak period began and ended,
- Time of day for beginning and end of each water-level drop interval,
- Each water-level drop measurement,
- Calculated percolation rate,
- Name and signature of person performing test,
- Name of owner or project name.

Rate Calculation

Percolation Rate = Time interval in minutes/Water-level drop in inches

MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY
PERCOLATION TEST FORM

Owner Name ____

Project Name ____

Lot of Tract Number ____________________ Test Number ______________

Diameter of Test Hole ____________________ Depth of Test Hole ____________

Date and Time Soak Period Began ______________ Ended ________________

Date Test Began ____

Distance of the reference point above the bottom of the hole ________________

Test Results

Start Time of Day	End Time of Day	Time Interval (Minutes)	Initial Distance Below Reference Point	Final Distance Below Reference Point	Drop in Water Level (inches)	Percolation Rate (minutes/inch)

I certify that this percolation test was done in accordance with DEQ-4, Appendix A.

______________________ ______________________ ______________
Name (printed) Signature Date

____
Company

~~PERCOLATION TEST PROCEDURE II~~

~~The consultant may use either or both tests in choosing the value used in site evaluation. The results of all tests must be reported in the application, and the procedure used must be specified. Test Procedure II requires substantially more data be obtained at well-defined intervals. If this information is not properly obtained, the results are not valid and will not be accepted. The percolation test must be completed by an individual approved by the reviewing authority.~~

~~*Note*: This test is run without a pre-soak time period, therefore results can be obtained in a shorter time period.~~

~~Depth of tests~~

~~Tests must be taken entirely within the most dense, least permeable soil identified at the approximate depth of the absorption trench, as identified from the test pit(s) on the site.~~

~~Type of test hole~~

~~The test hole must be unlined, shaped like a vertically oriented cylinder with a diameter of 6 to 8 inches.~~

~~Preparation of test hole~~

~~Using a sharp instrument, carefully scrape the side walls of the hole to remove any smeared surface. This is particularly important in soils having a significant silt or clay content. Place 1 inch of clean fine to medium gravel in the bottom of the hole to reduce scouring. After this process the evaluator may place a perforated pipe at least 4 inches in diameter in the center of the hole and surround it with the same gravel that is in the bottom. This must be done if the type of test hole required above cannot be constructed. This process will help keep the side walls from falling and causing the bottom to clog. When possible, instead of pouring water directly from a bucket into the hole, use a hose to siphon water out of a suitably located reservoir; this will provide a higher degree of control over the rate of water entering the hole, thereby minimizing scouring.~~

~~Percolation test measurements~~

~~To begin the test, fill the hole with water up to a level 6 inches above the stone and allow it to drop the distance specified in the table below for seven consecutive runs. After each run, bring the water up to the 6-inch level. The time of each run, the refill time between each run, and the total elapsed time must be accurately recorded.~~

	~~Soil Texture~~		
	~~Coarse to Medium Sand~~	~~Fine Sand to Silt Loam~~	~~Silts to Clay Loam~~
~~Anticipated Percolation Rate (min/inch)~~	~~1-10~~	~~10-60~~	~~60-120~~
~~Drop (inches)~~	~~2~~	~~1~~	~~0.5~~

~~Determining the percolation rate~~

~~The rate of drop for each run is plotted on graph paper, with logarithmic scales on both axes (log/log graph paper) against the cumulative time of the seven runs, including the refill time. The best straight line is fitted to the seven data points and extrapolated out to one day (1,440 minutes) of cumulative time. The rate of drop after 1,440 minutes is the percolation rate. A mathematical computation of the line of best fit of the seven or more data values may be used in lieu of the graphical method. The reviewing authority may require the mathematical computation of the line of best fit.~~

~~A typical data sheet is shown below, with units for each column noted below the table.~~

~~(1)~~	~~(2)~~	~~(3)~~	~~(4)~~	~~(5)~~	~~(6)~~	~~(7)~~	~~(8)~~
				~~t~~	~~T~~	~~H~~	
~~Test #~~	~~Time @ Begin of Test Run~~	~~Time @ End of Test Run~~	~~Fill Time (sec)~~	~~Time for Specific Drop (mm)~~	~~Total Time Since Start of Test (min)~~	~~Total Drop Since Start of Test (inches)~~	~~dT/dH min/inch~~
~~1~~	~~3:32:15~~	~~3:36:00~~	~~30~~	~~3.75~~	~~3.75~~	~~2~~	~~1.88~~
~~2~~	~~3:36:30~~	~~3:41:15~~	~~45~~	~~5.25~~	~~9.00~~	~~4~~	~~2.25~~
~~3~~	~~3:42:00~~	~~3:48:00~~	~~10~~	~~6.75~~	~~15.75~~	~~6~~	~~2.63~~
~~4~~	~~3:48:10~~	~~3:55:15~~	~~45~~	~~7.25~~	~~23.00~~	~~8~~	~~2.88~~
~~5~~	~~3:56:00~~	~~4:03:30~~	~~30~~	~~7.25~~	~~30.25~~	~~10~~	~~3.03~~
~~6~~	~~4:04:00~~	~~4:11:45~~	~~35~~	~~8.25~~	~~38.50~~	~~12~~	~~3.21~~
~~7~~	~~4:12:20~~	~~4:20:45~~		~~9.00~~	~~47.50~~	~~14~~	~~3.39~~

~~Common units:~~
~~Number of test cycle (show all if more were run)~~
~~Start of test periods in hours, minutes, seconds~~
~~End of test periods in hours, minutes, seconds~~
~~Time to refill the test hole with water (seconds)~~
~~t – time in minutes to drop the predetermined distance for the test period~~
~~T – total cumulative time in minutes since the start of the first test~~
~~H – total measured drop in inches of water in the test hole since the start of the test~~
~~dT/Dt – the rate of water drop in minutes per inch~~

~~Test results~~

~~Based on the graphical plot show below, the percolation rate at 1,440 minutes is about 7.5 minutes per inch. This is the design percolation rate.~~

Delete graph

APPENDIX B - SOILS AND SITE CHARACTERIZATION

Accurate description of soil types must be based on information within Appendix B for evaluating the soils in the area of proposed absorption system to determine if suitable conditions for wastewater treatment and disposal exist. Appendix B provides guidance for reporting soil characteristics using terminology generally accepted by the field of soil science.

Definitions

Bedrock means material that cannot be readily excavated by hand tools, or material that does not allow water to pass through or that has insufficient quantities of fines to provide for the adequate treatment and disposal of wastewater

~~Bedrock means material that cannot readily (easily) be excavated by hand tools power equipment, or material that is jointed, fractured, or has cohesive structure that does not allow water to pass through or has insufficient quantities of fines (less than 10%) within fractures or layers to allow to provide for the adequate treatment and disposal of wastewater.~~

.

Escarpment means any slope greater than 50 percent, which extends vertically 6 feet or more as measured from toe to top.

Limiting layer means bedrock, an impervious layer or seasonally high ground water.

Horizon means a layer in a soil profile that can be distinguished from each of the layers directly above and beneath it by having distinctly different soil physical, chemical, and/or biological characteristics.

Mottling or Redoximorphic features means soil properties associated with wetness that result from the reduction and oxidation of iron and manganese compounds in the soil after saturation and desaturation with water.

~~Mottling or redoximorphic features means soil properties associated with wetness that results from the reduction and oxidation of iron and manganese compounds in the soil after saturation with water and desaturation, respectively.~~

Natural soil means soil that has developed in place through natural processes, and to which no fill material has been added.

~~Natural soil means soil that has developed in place through natural processes, and where no fill material had been added.~~

Plasticity means the ability of a soil sample to be rolled into a wire shape with a diameter of 3 mm without crumbling.

Seasonally high ground water means the minimum depth, at any season of the year, to the upper surface of the zone of saturation, measured from the ground surface, as measured in an unlined hole or perforated monitoring well during the time of year when the water table is the highest. The term includes the upper surface of a perched water table.

Slope means the rate that a ground surface declines in feet per 100 feet. It is expressed as percent of grade.

Soil profile means a description of the soil strata to a depth of ~~7 to 10~~ eight feet using the USDA soil classification system.

Soil consistence means attributes of soil material as expressed in degree of cohesion and adhesion or in resistance to deformation on rupture. For the purposes of this Circular consistence includes: (1) resistance of soil material to rupture, (2) resistance to penetration, (3) plasticity, toughness, and stickiness of puddled soil material, and (4) the manner in which the soil material behaves when subject to compression. Although several tests are described, only those should be applied which may be useful.

Soil texture means the amount of sand, silt, or clay, measured separately in soil mixture.

Soil Texture

Soil texture refers to the weight proportion of the separates for particles less than 2 mm, as determined from a laboratory particle-size distribution. Field estimates should be checked against laboratory determinations, and field criteria should be adjusted as necessary. Field criteria for estimating soil texture must be chosen to fit the soils of the area. Sand particles feel gritty and can be seen individually with the naked eye. Silt particles cannot be seen individually without magnification; they have a smooth feel to the fingers when dry or wet. In some places, clay soils are sticky; in others, they are not. Soils dominated by montmorillonite clays, for example, feel different than soils that contain similar amounts of micaceous or kaolinitic clay.

Definitions of the soil texture classes according to distribution of size classes of mineral particles less than 2 mm in diameter are as follows:

Sands: 85 percent or more sand and the percentage of silt plus 1.5 times the percentage of clay is 15 or less.

Coarse sand: 25 percent or more very coarse and coarse sand and less than 50 percent any other single grade of sand.

Sand: 25 percent or more very coarse, coarse, and medium sand (but less than 25 percent very coarse and coarse sand) and less than 50 percent either fine sand or very fine sand.

Fine sand: 50 percent or more fine sand; or less than 25 percent very coarse, coarse, and medium sand and less than 50 percent very fine sand.

Very fine sand: 50 percent or more very fine sand.

Loamy sands: At the upper limit, 85 to 90 percent sand and the percentage of silt plus 1.5 times the percentage of clay is 15 or more; at the lower limit, 70 to 85 percent sand and the percentage of silt, plus twice the percentage of clay, is 30 or less.

Loamy coarse sand: 25 percent or more very coarse and coarse sand and less than 50 percent any other single grade of sand.

Loamy sand: 25 percent or more very coarse, coarse, and medium sand (but less than 25 percent very coarse and coarse sand) and less than 50 percent either fine sand or very fine sand.

Loamy fine sand: 50 percent or more fine sand; or less than 50 percent very fine sand and less than 25 percent very coarse, coarse, and medium sand.

Loamy very fine sand: 50 percent or more very fine sand.

Sandy loams: 20 percent or less clay and 52 percent or more sand and the percentage or silt plus twice the percentage of clay exceeds 30; or less than 7 percent clay, less than 50 percent silt, and between 43 and 52 percent sand.

Coarse sandy loam: 25 percent or more very coarse and coarse sand and less than 50 percent any other single grade of sand.

Sandy loam: 30 percent or more very coarse, coarse, and medium sand (but less than 25 percent very coarse and coarse sand) and less than 30 percent either fine sand or very fine sand.

Fine sandy loam: 30 percent or more fine sand and less than 30 percent; or between 15 to 30 percent very coarse, coarse, and medium sand; or more than 40 percent fine and very fine sand, at least half of which is fine sand, and less than 15 percent very coarse, coarse, and medium sand.

Very fine sandy loam: 30 percent or more very fine sand; or more than 40 percent fine and very fine sand, at least half of which is very fine sand, and less than 15 percent very coarse, coarse, and medium sand.

Loam: 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand.

Silt loam: 50 percent or more silt and 12 to 27 percent clay; or 50 to 80 percent silt and less than 12 percent clay.

Silt: 80 percent or more silt and less than 12 percent clay.

Sandy clay loam: 20 to 35 percent clay, less than 28 percent silt, and 45 percent or more sand.

Clay loam: 27 to 40 percent clay and 20 to 45 percent sand.

Silty clay loam: 27 to 40 percent clay and less than 20 percent sand.

Sandy clay: 35 percent or more clay and 45 percent or more sand.

Silty clay: 40 percent or more clay and 40 percent or more silt.

Clay: 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Necessarily these verbal definitions are somewhat complicated. The texture triangle is used to resolve problems related to word definitions. The eight distinctions in the sand and loamy sand groups provide refinement greater than can be consistently determined by field techniques. Only those distinctions that are significant ~~to use and management~~ and that can be consistently made in the field should be applied.

Particle size distribution

Particle-size distribution (fine earth or less than 2 mm) is determined in the field mainly by feel. The content of rock fragments is determined by estimating the proportion of the soil volume that they occupy.

Soil

The United States Department of Agriculture uses the following size separates for the <2-mm mineral material:

Very coarse sand: 2.0 – 1.0 mm
Coarse sand: 1.0 – 0.5 mm
Medium sand: 0.5 – 0.25 mm
Fine sand: 0.25 – 0.10 mm
Very fine sand: 0.10 – 0.05 mm
Silt: 0.05 – 0.002 mm
Clay: <0.002 mm

The texture classes are sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay, and clay. Subclasses of sand are subdivided into coarse sand, sand, fine sand, and very fine sand. Subclasses of loamy sands and sandy loams that are based on sand size are named similarly.

Rock fragments

Rock fragments are unattached pieces of rock 2 mm in diameter or larger that are strongly cemented or more resistant to rupture. Rock fragments include all sizes that have horizontal dimensions less than the size of a pedon.

Rock fragments are described by size, shape, and, for some, the kind of rock. The classes are pebbles, cobbles, channers, flagstones, stones, and boulders. If a size or range of sizes predominates, the class is modified, as for example: “fine pebbles,” “cobbles 100 to 150 mm in diameters,” “channers 25 to 50 mm in length.”

Gravel is a collection of pebbles that have diameters ranging from 2 to 75 mm. The terms “pebble” and “cobble” are usually restricted to rounded or subrounded fragments; however, they can be used to describe angular fragments if they are not flat. Words like chert, limestone, and shale refer to a kind of rock, not a piece of rock. The upper size of gravel is 3 inches (75 mm). The 5-mm and 20-mm divisions for the separation of fine, medium, and coarse gravel coincide with the sizes of openings in the “number 4” screen (4.76 mm) and the “3/4 inch” screen (19.05 mm) used in engineering.

The 75-mm (3-inch) limit separates gravel from cobbles. The 250-mm (10-inch) limit separates cobbles from stones, and the 600-mm (24-inch) limit separates stones from boulders. The 150-mm (channers) and the 380-mm (flagstones) limits for thin, flat fragments follow conventions used for many years to provide class limits for plate-shaped and crudely spherical rock fragments that have about the same soil use implications as the 250-mm limit for spherical shapes.

Rock fragments in soil

The adjectival form of a class name of rock fragments (Table B-1 C-1) is used as a modifier of the textural class name: “gravelly loam,” “stony loam.” The following classes, based on volume percentages, are used:

Less than 15 percent: No adjectival or modifying terms are used in writing for contrast with soils having less than 15 percent pebbles, cobbles, or flagstones. The adjective “slightly” may be used; however, to recognize those soils used for special purposes.

15 to 35 percent: The adjectival term of the dominant kind of rock fragment is used as a modifier of the textural terms: “gravelly loam,” “channery loam,” “cobbly loam.”

35 to 60 percent: The adjectival term of the dominant kind of rock fragment is used with the word “very” as a modifier of the textural term: “very gravelly loam,” “very flaggy loam.”

More than 60 percent: If enough fine earth is present to determine the textural class (approximately 10 percent or more by volume), the adjectival term of the dominant kind of rock fragment is used with the word “extremely” as a modifier of the textural term: “extremely gravelly loam,” “extremely bouldery loam.” If there is too little fine earth to determine the textural class (less than about 10 percent by volume), they term “gravel,” “cobbles,” “stones,” or “boulders” is used as appropriate.

The class limits apply to the volume of the layer occupied by all pieces of rock larger than 2 mm. The soil generally contains fragments smaller or larger than those identified in the term. For example, a stony loam usually contains pebbles, but “gravelly” is not mentioned in the name. The use of a term for larger pieces or rock, such as boulders does not imply that the pieces are entirely within a given soil layer. A simple boulder may extend through several layers.

Table B-1
Terms for Rock Fragments

Shape and size	Noun	Adjective
Spherical, cubelike, or equiaxial:		
2-75 mm diameter	Pebbles	Gravelly
2-5 mm diameter	Fine	Fine gravelly
5-20 mm diameter	Medium	Medium gravelly
20-75 mm diameter	Coarse	Coarse gravelly
75-250 mm diameter	Cobbles	Cobbly
250-600 mm diameter	Stones	Stony
> 600 mm diameter	Boulders	Bouldery
Flat:		
2-150 mm long	Channers	Channery
150-380 mm long	Flagstones	Flaggy
380-600 mm long	Stones	Stones
> 600 mm long	Boulders	Bouldery

Table B-2
Classes of Surface Stones and Boulders in Terms of Cover and Spacing

Class	Percentage of surface covered	Distance in meters between stones or boulders if the diameter is:			Name
		0.25m[1]	0.6m	1.2m	
1	0.01 – 0.1	>8	>20	>37	Stony or bouldery
2	0.1 – 3.0	1 – 8	3 – 20	6 – 37	Very stony or very bouldery
3	3.0 – 15	0.5 – 1	1 –3	2 - 6	Extremely stony or extremely bouldery
4	15 – 50	0.3 – 0.5	0.5 – 1	1 – 2	Rubbly
5	50 – 90	<0.3	<0.05 – 1	<1	Very rubbly

[1] 0.38 m if flat

Soil Color

Elements of soil color descriptions are the color name, the Munsell notation, the water state, and the physical state: “brown (10YR 5/3), dry, crushed, and smoothed.”

Physical state is recorded as broken, rubbed, crushed, or crushed and smoothed. The term “crushed” usually applies to dry samples and “rubbed” to moist samples. If unspecified, the surface is broken. The color of the soil is recorded for a surface broken through a ped, if a ped can be broken as a unit.

The color value of most soil material becomes lower after moistening. Consequently, the water state of a sample is always given. The water state is either “moist” or “dry.” The dry state for color determinations is air-dry and should be made at the point where the color does not change with additional drying. Color in the moist state is determined on moderately moist or very moist soil material and should be made at the point where the color does not change with additional moistening. The soil should not be moistened to the extent that glistening takes place, as color determinations of wet soil may be in error because of the light reflection of water films.

Munsell notation is obtained by comparison with a Munsell system color chart. The most commonly used chart includes only about one-fifth of the entire range of hues. It consists of about 250 different colored papers, or chips, systematically arranged on hue cards according to their Munsell notations.

The Munsell color system uses three elements of color – hue, value, and chroma – to make up a color notation. The notation is recorded in the form: hue, value/chroma – for example, 5Y 6/3.

Hue is a measure of the chromatic composition of light that reaches the eye. The Munsell system is based on five principle hues: red (R), yellow (Y), green (G), blue (B), and purple (P). Five intermediate hues representing midpoints between each pair of principle hues complete the 10 major hue names used to describe the notation. The intermediate hues are yellow-red (YR), green-yellow (GY), blue-green (BG), purple-blue (PB), and red-purple (RP).

Value indicates the degree of lightness or darkness of a color in relation to a neutral gray scale. On a neutral gray (achromatic) scale, value extends from pure black (0/) to pure white (10/). The value notation is a measure of the amount of light that reaches the eye under standard lighting conditions.

Chroma is the relative purity or strength of the spectral color. Chroma indicates the degree of saturation of neutral gray by the spectral color. The scales of chroma for soils extend from /0 to a chroma of /8 as the strongest expression of color used for soils.

Conditions for Measuring Color

The quality and intensity of the light affect the amount and quality of the light reflected from the sample to the eye. The moisture content of the sample and the roughness of its surface affect the light reflected. The visual impression of color from the standard color chips is accurate only under standard conditions of light intensity and quality. Color determination may be inaccurate early in the morning or late in the evening. When the sun is low in the sky or the atmosphere is smoky, the light reaching the sample and the light reflected is redder. Even though the same kind of light reaches the color standard and the sample, the reading of sample color at these times is commonly one or more intervals of hue redder than at midday. Colors also appear different in the subdued light of a cloudy day than in bright sunlight. If artificial light is used, as for color determinations in an office, the light source used must be as near the white light of midday as possible. With practice, compensation can be made for the differences, unless the light is so subdued that the distinctions between color chips are not apparent. The intensity of incidental light is especially critical when matching soil to chips of low chroma and low value.

Roughness of the reflecting surface affects the amount of reflected light, especially if the incidental light falls at an acute angle. The incidental light should be as nearly as possible at a right angle. For crushed samples, the surface is smoothed; the state is recorded as “dry, crushed, and smoothed.”

Recording guidelines

Uncertainty Under field conditions, measurements of color are reproducible by different individuals within 2.5 units of hue (one card) and 1 unit of value and chroma.

Dominant color The dominant color is the color that occupies the greatest volume of the layer. Dominant color (or colors) is always given first among those of a multicolored layer. It is judged on the basis of colors of a broken sample. For only two colors, the dominant color makes up more than 50 percent of the volume. For three or more colors, the dominant color makes up more of the volume of the layer than any other color, although it may occupy less than 50 percent.

Mottling refers to repetitive color changes that cannot be associated with compositional properties of the soil. Redoximorphic features are a type of mottling that is associated with wetness. A color pattern that can be related to the proximity to a ped surface of other organizational or compositional feature is not mottling. Mottle description follows the dominant color. Mottles are described by quantity, contrast, color, and other attributes in that order.

Quantity is indicated by three areal percentage classes of the observed surface:

Few: less than 2 percent,
Common: 2 to 20 percent, and
Many: more than 20 percent.

The notations must clearly indicate to which colors the terms for quantity apply.

Size refers to dimensions as seen on a plane surface. If the length of a mottle is not more than two or three times the width, the dimension recorded is the greater of the two. If the mottle is long and narrow, as a band of color at the periphery of a ped, the dimension recorded is the smaller of the two and the shape and location are also described. Three size classes are used:

Fine: smaller than 5 mm,
Medium: 5 to 15 mm, and
Coarse: larger than 15 mm.

Contrast refers to the degree of visual distinction that is evident between associated colors:

Faint: Evident only on close examination, faint mottles commonly have the same hue as the color to which they are compared and differ by no more than 1 unit of chroma or 2 units of value. Some faint mottles of similar but low chroma and value differ by 2.5 units (one card) of hue.

Distinct: Readily seen but contrast only moderately with the color to which they are compared. Distinct mottles commonly have the same hue as the color at which they are compared but differ by 2 to 4 units of chroma or 3 to 4 units of value; or differ from the color to which they are compared by 2 units (one card) of hue but by no more than 1 unit of chroma or 2 units of value.

Prominent: Contrast strongly with the color to which they are compared. Prominent mottles are commonly the most obvious color feature of the section described. Prominent mottles that have medium chroma and value commonly differ from the color to which they are compared by at least 5 units (two pages) of hue if chroma and value are the same; at least 4 units of value or chroma if the hue is the same; or at least 2 unit of chroma or 2 units of value if hue differs by 2.5 units (one card).

Contrast is often not a simple comparison of one color with another but is a visual impression of the prominence of the one color against a background commonly involving several colors.

Soil structure

Soil structure refers to units composed of primary particles. The cohesion within these units is greater than the adhesion among units. As a consequence, under stress, the soil mass tends to rupture along predetermined planes or zones. Three planes or zones, in turn, form the boundary. A structural unit that is the consequence of soil development is called a ped. The surfaces of peds persist through cycles of wetting and drying in place. Commonly, the surface of the ped and its interior differ as to composition or organization, or both, because of soil development.

Some soils lack structure and are referred to as structureless. In sturctureless layers or horizons, no units are observable in place or after the soil has been gently disturbed, such as by tapping a space containing a slice of soil against a hard surface or by dropping a large fragment on the ground. When structureless soils are ruptured, soil fragments, single grains, or both, result. Structureless soil material may be either single grain or massive. Soil material of single grains lacks structure. In addition, it is loose. On rupture, more than 50 percent of the mass consists of discrete mineral particles.

Some soils have simple structure, each unit being an entity without component smaller units. Others have compound structure, in which large units are composed of smaller units separated by persistent planes of weakness.

In soils that have structure, the shape, size, and grade (distinctness) of the units are described. Field terminology for soil structure consists of separate sets of terms designating each of the three properties, which by combination form the names for structure.

Shape

Several basic shapes of structural units are recognized in soils.

Platy: The units are flat and platelike. They are generally oriented horizontally. A special form, lenticular platy structure, is recognized for plates that are thickest in the middle and thin toward the edges.

Prismatic: The individual units are bounded by flat to rounded vertical faces. Units are distinctly longer vertically, and the faces are typically casts or molds of adjoining units. Vertices are angular or subrounded; the tops of prisms are somewhat indistinct and normally flat.

Columnar: The units are similar to prisms and are bounded by flat or slightly rounded vertical faces. The tops of columns, in contrast to those prisms, are very distinct and normally rounded.

Blocky: The units are block like or polyhedral. They are bounded by flat or slightly rounded surfaces that are casts of the faces of surrounding peds. Typically, blocky structural units are nearly equidimensional but grade to prisms and to plates. The structure is described as angular blocky if the faces intersect at relatively sharp angles; a subangular blocky if the faces are a mixture of rounded and plane faces and the corners are mostly rounded.

Granular: The units are approximately spherical or polyhedral and are bounded by curved or very irregular faces that are not casts of adjoining peds.

Size

Five classes are employed: very fine, fine, medium, coarse, and very coarse. The size limits differ according to the shape of the units. The size limit classes are given in Table B-3. The size limits refer to the smallest dimension of plates, prisms, and columns.

Table B-3
Size Classes of Soil Structure

Shape of Structure

Size Classes	Platy1 mm	Prismatic & Columnar mm	Blocky mm	Granular mm
Very Fine	<1	<10	<5	<1
Fine	1 – 2	10 – 20	5 – 10	1 – 2
Medium	2 – 5	20 – 50	10 – 20	2 – 5
Coarse	5 – 10	50 – 100	20 – 50	5 – 10
Very Coarse	>10	>100	>50	>10

1 In describing plates, “thin” is used instead of “fine” and “thick” instead of “coarse.”

Grade

Grade describes the distinctness of units. Criteria are the ease of separation into discrete units and the proportion of units that hold together when the soil is handled. Three classes are used:

Weak: The units are barely observable in place. When gently disturbed, the soil material parts into a mixture of whole and broken units and much material that exhibits no planes of weakness. Faces that indicate persistence through wet-dry-wet cycles are evident if the soil is handled carefully. Distinguishing structurelessness from weak structure is sometimes difficult. Weakly expressed structural units in virtually all soil materials have surfaces that differ in some way from the interiors.

Moderate: The units are well formed and evident in undisturbed soil. When disturbed, the soil material parts into a mixture of mostly whole units, some broken units, and material that is not in units. Peds part from adjoining peds to reveal nearly entire faces that have properties distinct from those of fractured surfaces.

Strong: The units are distinct in undisturbed soil. They separate cleanly when the soil is disturbed. When removed, the soil material separates mainly into whole units. Peds have distinctive surface properties.

Three terms for soil structure are combined in order (1) grade, (2) size, (3) shape. "Strong fine granular structure" is used to describe a soil that separates almost entirely into discrete units that are loosely packed, roughly spherical, and mostly between 1 and 2 mm in diameter.

Compound structure

Smaller structural units may be held together to form larger units. Grade, size, and shape are given for both, and the relationship of one set to the other is indicated: "strong medium blocks within moderate coarse prisms," or "moderate coarse prismatic structure parting to strong medium blocky."

Concentrations

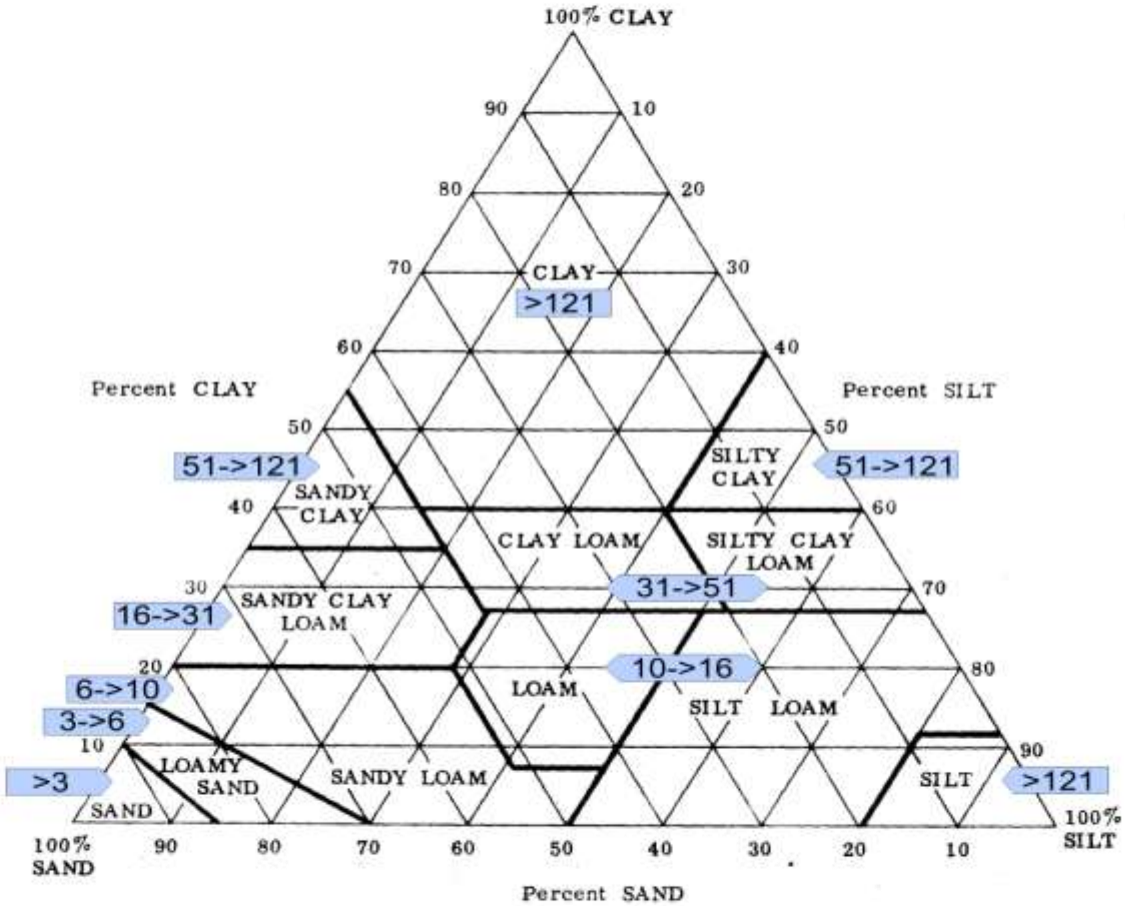
The features discussed here are identifiable bodies within the soil that were formed by pedogenesis. Some of these bodies are thin and sheetlike; some are nearly equidimensional; others have irregular shapes. They may contrast sharply with the surrounding material in strength, composition, or internal organization. Masses are non-cemented concentrations of substances that commonly cannot be removed from the soil as a discrete unit. Most accumulations consist of calcium carbonate, fine crystals of gypsum or more soluble salts, or iron and manganese oxides. Except for very unusual conditions, masses have formed in place.

Nodules and concretions are cemented bodies that can be removed from the soil intact. Composition ranges from material dominantly like that of the surrounding soil to nearly pure chemical substances entirely different from the surrounding material.

Concretions are distinguished from nodules on the basis of internal organization. Concretions have crude internal symmetry organized around a point, a line, or a plane. Nodules lack evident, orderly internal organization.

Textural Triangle

Soil Percolation Rate min/in



APPENDIX C - GROUND WATER OBSERVATION WELL INSTALLATION AND MEASURING PROCEDURES

Observation Schedule

Observation must be done during the time when ground water levels are highest. This is typically during spring runoff or during the irrigation period, but may also be at some other time during the year. Observation must be done weekly or more frequently during the appropriate periods of suspected high ground water. Observation must include at least two weeks of observation prior to and after the ground water peak, otherwise the reviewing authority may reject the results. The applicant is encouraged to consult with the state and/or county before installing wells. The monitoring must be completed by an individual approved by the reviewing authority.

Surface water levels may be indicative of the ground water levels that may peak several weeks after spring runoff and irrigation seasons.

Local conditions may indicate that there is more than one geologic horizon that can become seasonally saturated. This may require observation wells to be installed at different horizons. The well should be placed in, but not extended through, the horizon that is to be monitored.

The reviewing authority may refuse to accept seasonal high ground water data when the total precipitation for the previous year (defined as May 1 of the previous year to April 30 of the current year), of April 1 snowpack equivalent, measured at the nearest officially recognized observation station, is more than 25 percent below the 30-year historical average. This is based upon the definition of drought conditions created by the National Drought Mitigation Center. The reviewing authority may consider soil morphology and data from nearby ground water observation sites with similar soil, geology, and proximity to streams or irrigation ditches, if available, to determine maximum ground water elevation during periods of drought.

Where to Install

The observation well(s) must be installed within 25 feet of the proposed absorption trench and on the same elevation. The reviewing authority may require the placement of the well(s) in an exact location. Additional observation wells may be required if the recommended observation sites show ground water higher than 6 feet below the ground surface.

Installation Process

The well must be installed vertically into a dug or drilled hole.

A slotted water well pipe should be used that is 2 to 4 inches in diameter and 10 feet long.

A. Slotted pipe (PVC is the most common material) with slot sizes between 40 and 100 (i.e. slot widths between 0.04 and 0.10 inches wide) is suggested. Slots should be horizontal and spaced at intervals less than or equal to 0.5 inches.

B. Check with the reviewing authority to determine if an alternate well material is acceptable.

The pipe should be perforated from 1 foot below ground surface to 8 feet below the ground surface unless multiple horizons exist.

The casing must be unperforated 1 foot below ground surface to the top of the well. The well must extend at least 2 feet above the ground surface.

The top of the well must be sealed with a watertight cap.

The area around the well must be backfilled with native material to 1 foot below ground surface.

The well must be sealed in such a manner that prevents surface runoff from running along the outside of the well casing. The well should be sealed from 1 foot below ground surface to slightly above grade to allow for subsidence and to maintain a positive ground slope away from well casing. The material used to seal the well can be either fine-grained material or bentonite.

Each observation well should be flagged to facilitate locating the well and labeled with the lot number, location, and subdivision name.

Measuring Procedures

Lower a measuring tape or stick to the water level and measure the distance from the water level to the top of the pipe (see example, the next page). Water levels should be measured to the nearest inch. A plunking device or electronic water sensor can also be used. Data should be submitted in a similar form to that of the example.

Measure the distance from the top of the pipe to the natural ground surface; this is B distance (see example). Then measure the distance from the top of the pipe to the water level; this is A (see example). Subtract B from A; this value equals the actual separation between the water table and the natural ground surface.

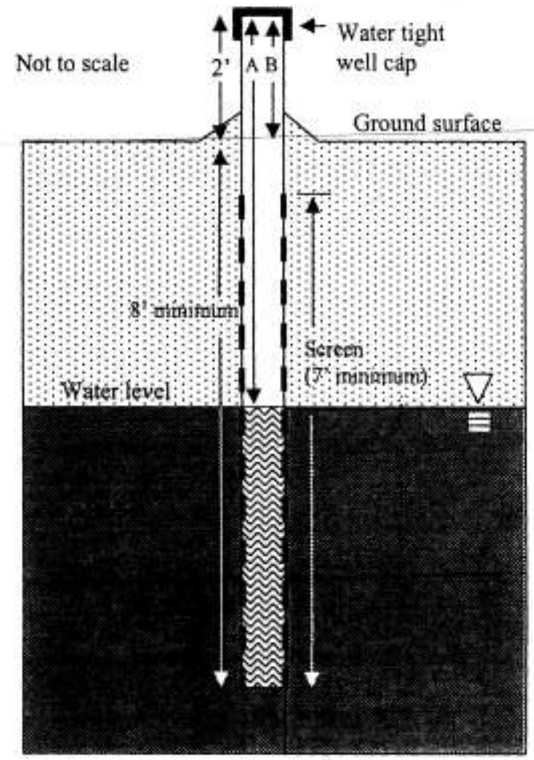
Ground Water Observation Results
Monitored By:
Location :
Section __________ Township________ Range_____ Lot #_____
Observation Well # ________

Other Location Information:

Date	Time	A (inches)	B (inches)	A-B (inches)

A= Distance to top of casing to the ground water level in pipe (inches).
Note: If the observation pipe is dry, enter the total depth measured and "dry" in this column.
B= Distance from top of casing to the natural ground surface (inches).

Ground Water Observation Well Design



APPENDIX D - OPERATION AND MAINTENANCE PLAN

Continued service and maintenance of the wastewater system must be addressed for the life of the system by an approved operation and maintenance plan.

~~Wastewater treatment systems are to be operated and maintained in accordance with the manufacturer's instructions.unless a written exception to those procedures has been approved by the reviewing authority and the product manufacturer~~

The owner of the residence or facility ~~served by the system~~ is responsible for assuring proper operation and providing timely maintenance of the system. ~~unit~~. ~~The septic tank or other primary or settling tanks must be pumped as specified by manufacturer and in accordance with Chapter 7.The authorized representative for the system must instruct or assure that instruction regarding proper operation of the system is provided to the owner of the residence or facility.~~ A copy of the approved operation and maintenance plan must be given to the local health department for their files. Some health departments may require that this document be presented in electronic format. If observations reveal a system failure, absorption trench failure or history of ~~long-term, continuous, and increasing~~ effluent ponding within the absorption trench, the owner of the system must take appropriate action. ~~according to the direction and satisfaction of the reviewing authority, to alleviate the situation.~~ . Notification to the local health department and if appropriate, the service provider, must be made within two business days if any unit of the system fails to function properly.

~~Continued service and maintenance must be addressed for the life of the system by an operation plan~~

The reviewing authority will consider the complexity and maintenance required of the system along with the stability of the processes in determining the adequacy, level of maintenance, and monitoring frequency of the system. The monitoring frequency should be sufficient to establish the treatment efficiency and response to varying wastewater flows, strengths, and climatic condition.

The operation and maintenance plan must include the following: an owner's manual, a system installation manual, an operation and maintenance manual and as-built plans with the name of the designer and installer.

Owner's manual

A comprehensive owner's manual must be submitted to the reviewing authority and include: ~~for the wastewater system. The manual may be a collection of individual system component manuals. This document must include a system installation manual, an operation and maintenance manual, a troubleshooting and repair manual, and as-built plans with the name of the designer and installer.~~

~~The information in this manual must include:~~

A. A clear statement providing examples of the types of waste that can be effectively treated by the system;

B. Requirements for periodic removal of residuals from the system; the septic tank, grease trap or other settling tanks should be pumped as specified by manufacturer;

C. A course of action to be applied if the system will be used intermittently, or if extended periods of non-use are anticipated;

D. The name and telephone number of a service representative, pumpers and the local health department to be contacted in the event that the system experiences a problem; and

E. Description of the initial and extended service policies.

~~Emergency contact numbers for service providers, pumpers, the local health department, and the reviewing authority.~~

Installation manual

~~The~~ A comprehensive installation manual must be submitted to the reviewing authority and include:

A. A numbered parts list of system components with accompanying illustrations, photographs, or prints in which the components are respectively identified;

B. Design, construction, and material specifications for the system's components;

C. Schematic drawings of the system's electrical components;

D. A process overview explaining the function of each component and a description of how the entire system functions when all components are properly assembled and connected;

E. A clear description of installation requirements for, but not limited to, plumbing, electrical power, ventilation, air intake protection, bedding, hydrostatic displacement protection (floating in high ground water conditions), watertightness, slope, and miscellaneous fittings and appurtenances;

F. A sequential installation procedure from the residence out to the effluent discharge connection; and

G. A detailed start-up procedure.

Operations and maintenance manual

Comprehensive instruction in the operation and maintenance of the system must be provided to the reviewing authority and must include: ~~The system designer or manufacturer must provide comprehensive and detailed operation and maintenance instructions to the reviewing authority. The operation and maintenance manual must include~~:

A. Maintenance procedures and schedules for all components;

B. Requirements and recommended procedures for periodic removal of residuals from the system;

C. A detailed procedure for visually evaluating function of system components; and

D. Safety concerns that may need to be addressed.

As-built plans

A comprehensive set of as-built plans must be submitted to the reviewing authority and include the name of the designer and installer. As-builts will be added to the operation and maintenance plan after initial approval and construction of the system.

~~**Service-related obligations**~~

Proprietary and High Strength Wastewater Treatment Systems

In addition to the requirements of this appendix, all proprietary and high strength wastewater treatment systems must have both an initial and a renewed service contract for the life of the system. ~~or through other means approved by the reviewing authority.~~ Service contracts must include:

A. Owner's name and address;

B. Property address and legal description;

C. Local health department permit requirements;

D. Detail of service to be provided. The owner must be notified, in writing, about any improper system function that cannot be remedied during the time of inspection, and an estimate for the date of correction;

E. Schedule of service provider duties. Initial two-year service policies must stipulate a minimum of four inspection/service visits (scheduled at least once every six months over the two-year period) during which electrical, mechanical, and other components are inspected, adjusted, and serviced;

F. Cost and length of service contract/time period;

G. Details of product warranty; and

H. Owner's responsibilities;

Service providers must maintain accurate records of their service contracts, customers, performance data, and time lines for renewing the contracts. These records must be available for inspection upon request by the reviewing authority. ~~The reviewing authority may require copies of these records to be submitted.~~

~~A two-year initial service policy must be furnished to the owner by the designer, manufacturer or authorized representative with the following conditions.~~

A. ~~The initial service policy must contain provisions for four inspection/service visits (scheduled once every six months over the two-year period) during which electrical, mechanical, and other components are inspected, adjusted, and serviced;~~

B. ~~The service policy must contain a clause stating that the owner must be notified, in writing, about any improper system function that cannot be remedied during the time of inspection, and the written notification must include an estimated date of correction by the designer, manufacturer or its representative.~~

~~Service providers must maintain accurate records of their service contracts, customers, performance data, and time lines for renewing the contracts. These records must be available for inspection upon request by the reviewing authority. The reviewing authority may require copies of these records to be submitted.~~

The designer, manufacturer or authorized representative must make available, for purchase by the owner, an extended service policy with terms comparable to those of the initial service policy, which includes operation and maintenance ~~O & M~~ service for the entire wastewater system. The service provider must notify the reviewing authority and local health department of service contracts that are not renewed.

In the event that a mechanical or electrical component of the system requires off-site repair, the local authorized representative must maintain a stock of mechanical and electrical components that can be temporarily installed until repairs are completed if repairs are expected to render the unit inoperable for longer than 24 hours.

Emergency service must be available within 48 hours of a service request.

APPENDIX E - DESIGN EXAMPLES

Elevated Sand Mound

ELEVATED SAND MOUND - DESIGN EXAMPLE

Parameters:

4-bedroom house

Design Flow: 350 gallons per day (gpd)

Land Slope: Flat

Underlying Soil Type: Clay Loam

Soil Application Rate: 0.3 gallons per day per square foot (gpd/sf)

Sand Loading Rate per DEQ-4: 0.8 gpd/sf

Basal Loading Rate per DEQ-4: 0.3 gpd/sf

Bed size based upon sand loading rate:

350 gpd ÷ 0.8 gpd/sf = 438 sf of required absorption area.

Required Minimum Basal Area based upon soil loading rate:

350 gpd ÷ 0.3 gpd/sf = 1,167 sf of Basal Area required.

Montana Department of Environmental Quality	Scale: NTS	Elevated Sand Mound Design Parameters	Dwg. No. ESM-1

BED DESIGN

438 sf of bed required.

§6.6.3.7 requires a minimum 3:1 ratio of length to width.

Let "x" = width, then "3x = length

Thus:

$3x^2 = 438$

$x = \sqrt{438/3}$

x = 12.08' ; 3x = 32.25'

Round to 12.5' x 37.5' so §6.6.3.7 is still met.

Check Basal Area Requirements:

Overall Width of Mound:

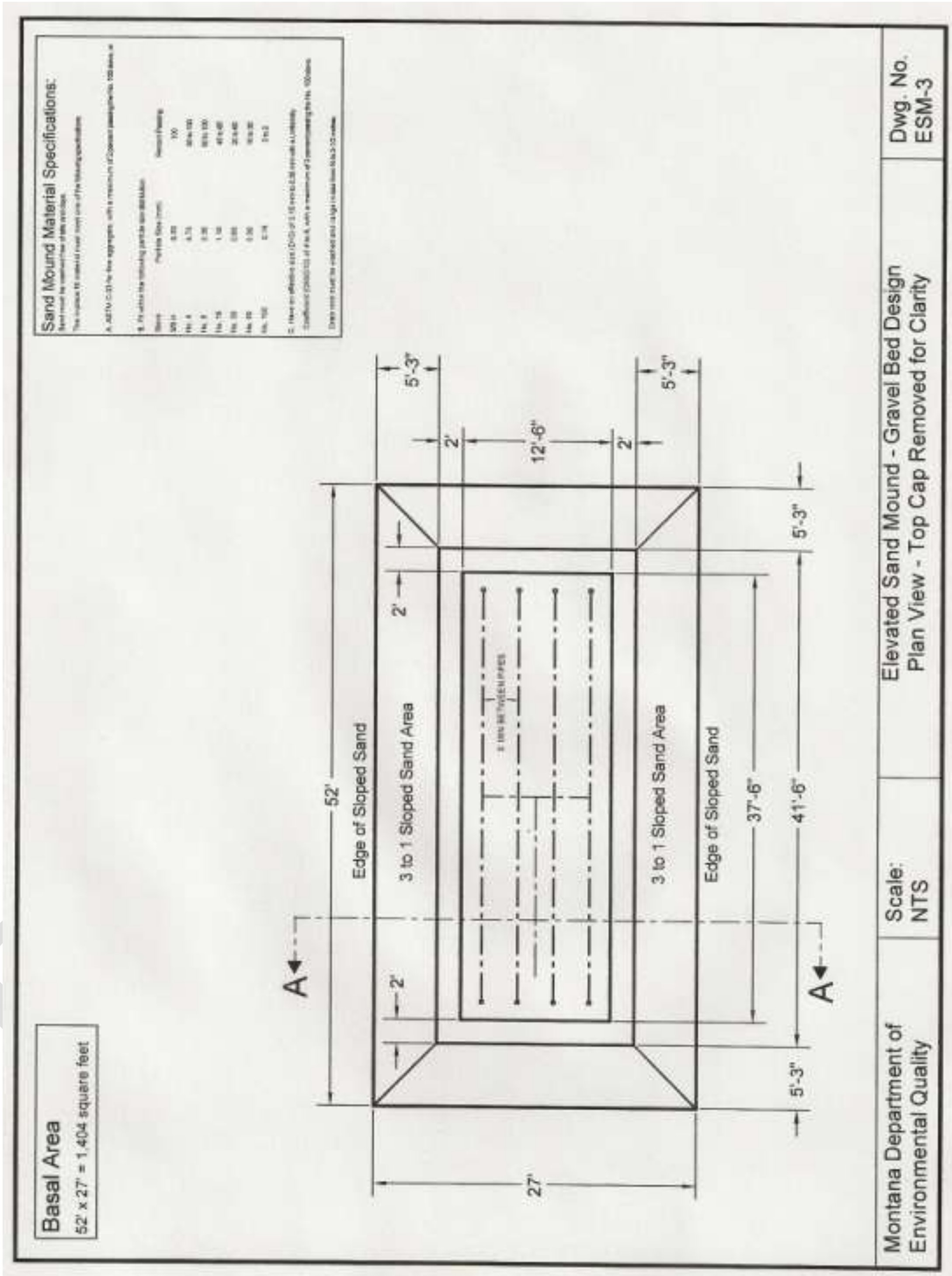
5.25' + 2' + 12.5' + 2' + 5.25' = 27'

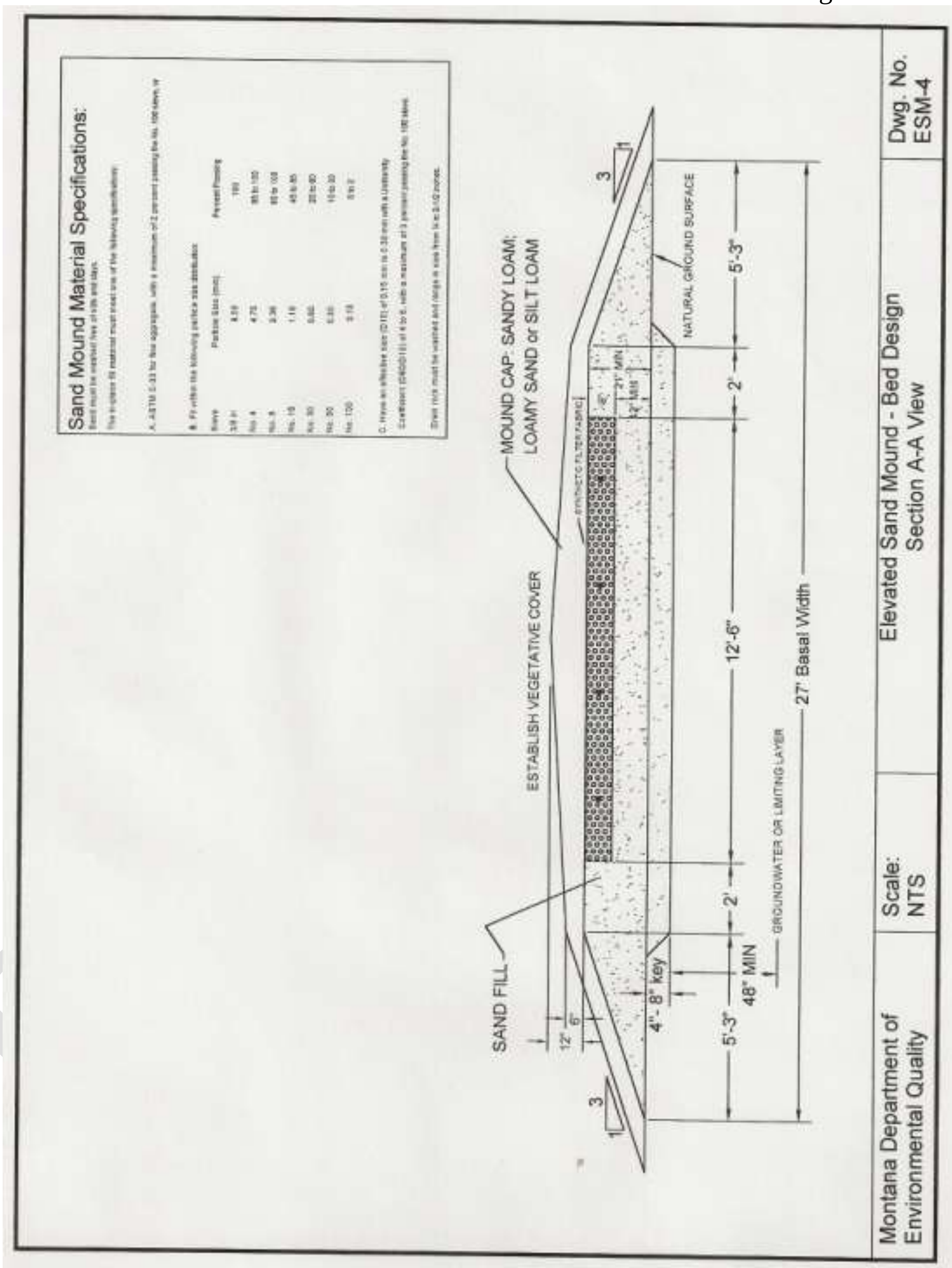
Overall Length of Mound:

5.25' + 2' + 37.5' + 2' + 5.25' = 52'

52' x 27' = 1,404 sf > 1,167 sf so §6.6.3.3 requirement met

Montana Department of Environmental Quality	Scale: NTS	Elevated Sand Mound Gravel Bed Design Parameters	Dwg. No. ESM-2


Sand Mound Material Specifications:
Basal Area
52' x 27' = 1,404 square feet
52'
Edge of Sloped Sand
3 to 1 Sloped Sand Area
3 to 1 Sloped Sand Area
Edge of Sloped Sand
37'-6"
41'-6"
27'
5'-3"
5'-3"
5'-3"
5'-3"
2'
2'
2'
2'
12'-6"
A
A
Montana Department of
Environmental Quality
Scale:
NTS
Elevated Sand Mound - Gravel Bed Design
Plan View - Top Cap Removed for Clarity
Dwg. No.
ESM-3


Sand Mound Material Specifications:
MOUND CAP- SANDY LOAM; LOAMY SAND or SILT LOAM
ESTABLISH VEGETATIVE COVER
SYNTHETIC FILTER FABRIC
21" MIN
SAND FILL
12"
6"
4"- 8" key
48" MIN
3
1
NATURAL GROUND SURFACE
GROUNDWATER OR LIMITING LAYER
5'-3"
2'
12'-6"
2'
5'-3"
27' Basal Width
Montana Department of Environmental Quality
Scale: NTS
Elevated Sand Mound - Bed Design Section A-A View
Dwg. No. ESM-4

Evaportanspiration Absorption System Example

EVAPOTRANSPIRATION ABSORPTION SYSTEM - DESIGN EXAMPLE

Parameters: 4-bedroom house near Terry; design flow 350 gallons per day (gpd)

Land Slope: Flat;   Underlying Soil Type: Clay

Soil Application Rate Based Upon Percolation Test: 0.15 gpd/sf (Section 6.7.3.5)

Bed Material Void Ratio 40 %

Required Factor of Safety: 1.5 (per Section 6.7.3.7)

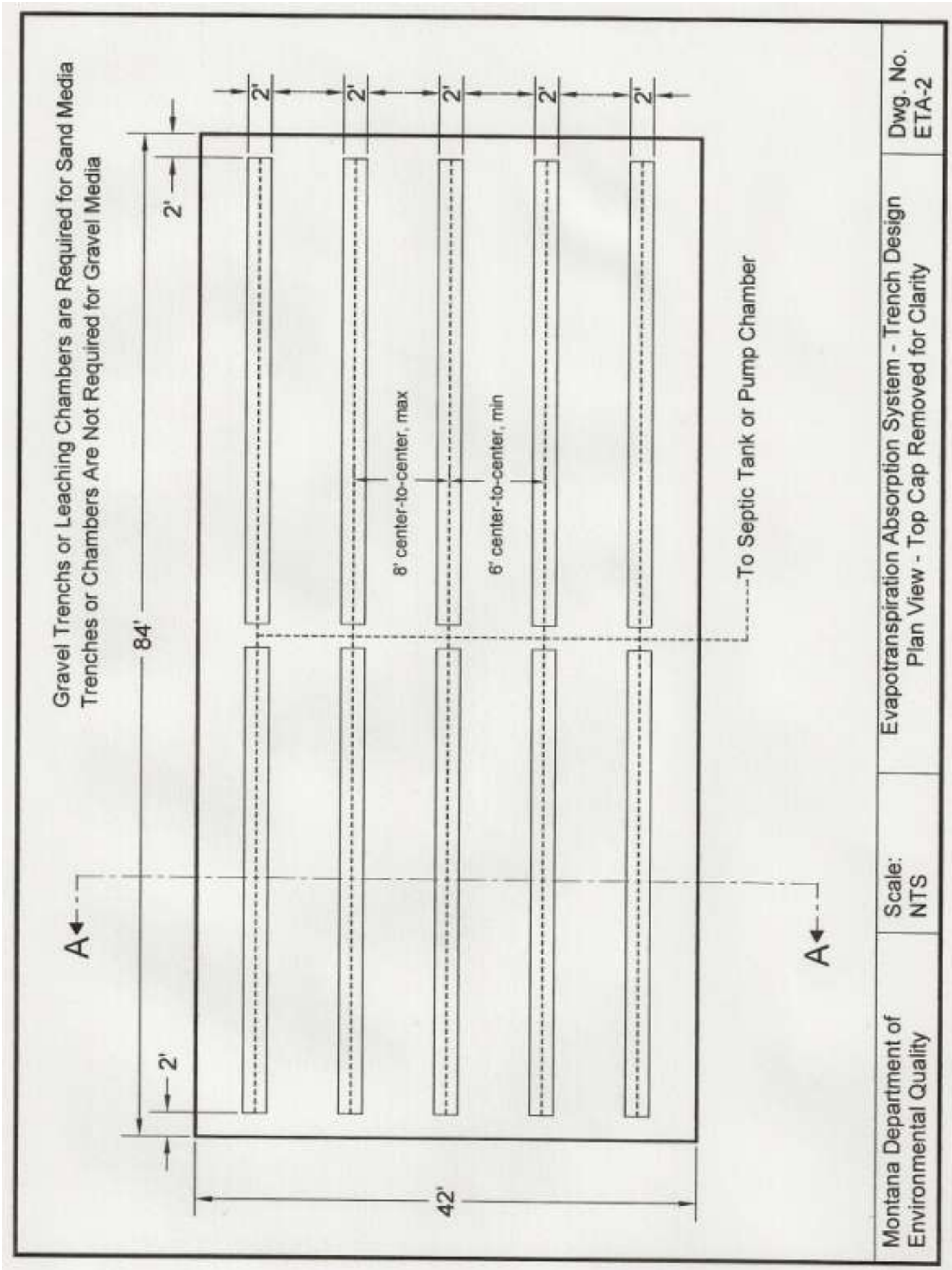
ET Bed Size Based Upon Maximum Allowed Application Rate: 0.15gpd/sf (per Section 6.7.3.5)

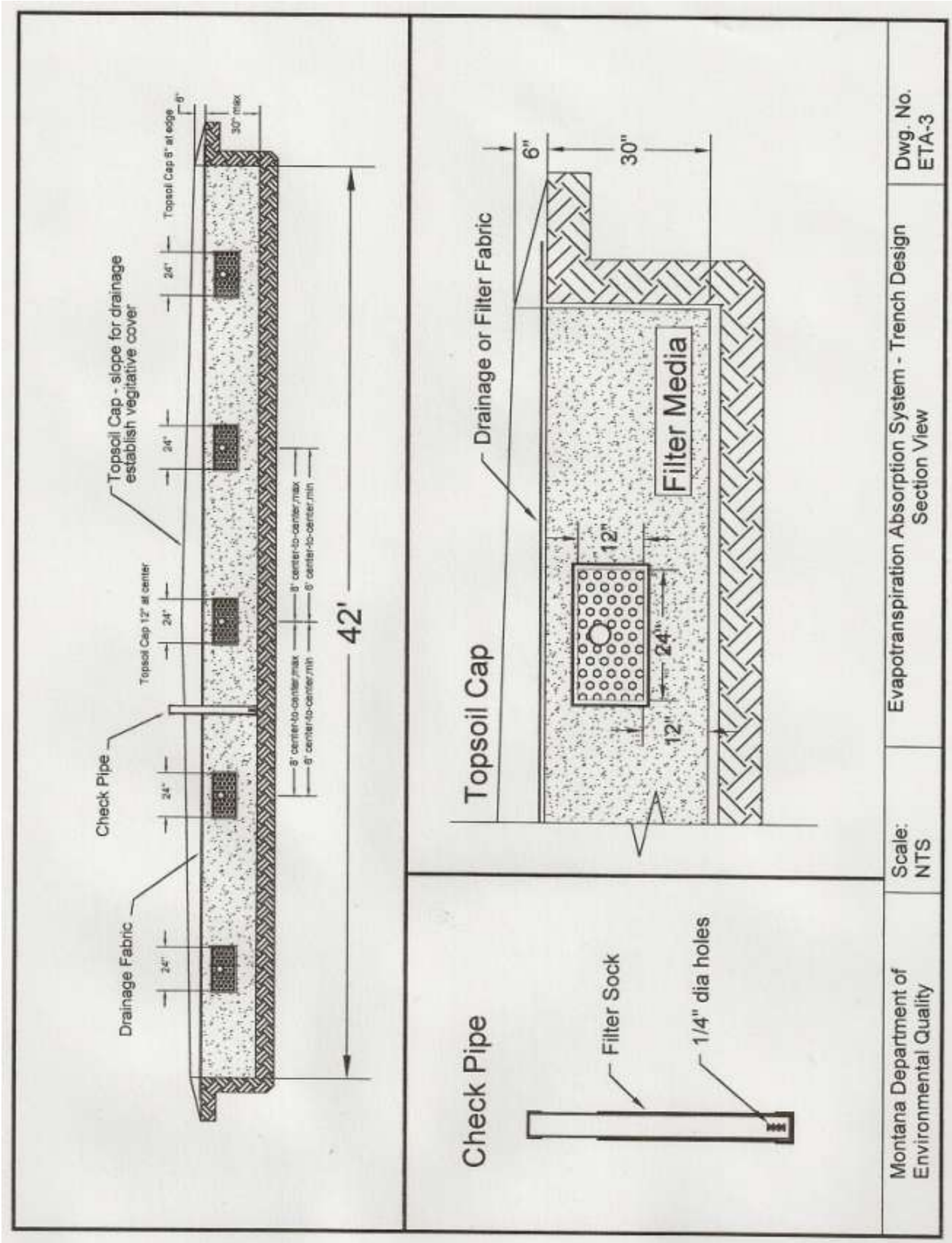
350/0.15 = 2,333 square feet.   2,333 square feet x 1.5 factor of safety = 3,500 square feet

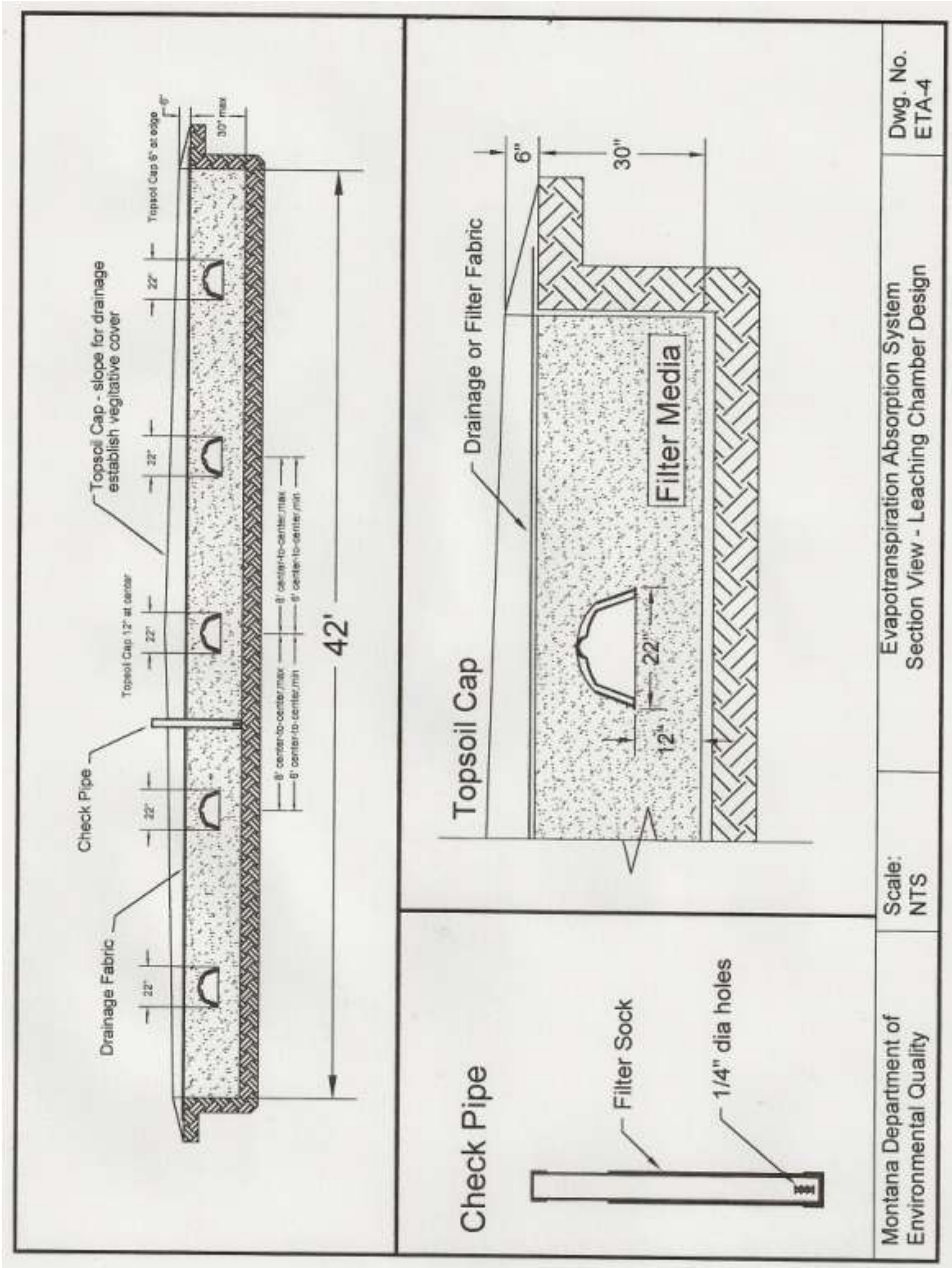
Bed Dimensions: Square 59' x 59'

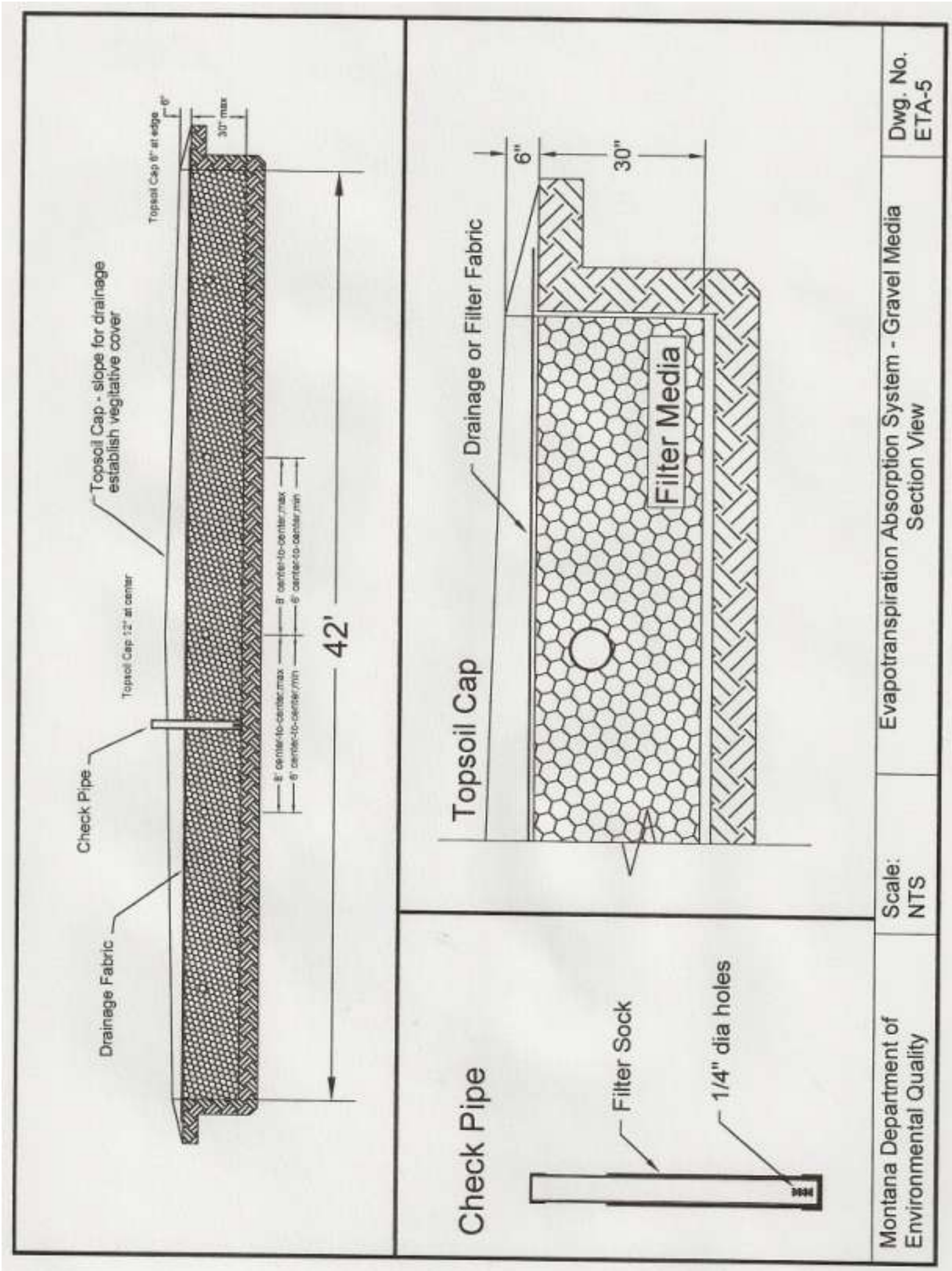
Bed Dimensions: 2:1 Rectangle 42' x 84'

Montana Department of Environmental Quality	Scale: NTS	Evapotranspiration Absorption System Design Parameters	Dwg. No. ETA-1


Gravel Trenchs or Leaching Chambers are Required for Sand Media
Trenches or Chambers Are Not Required for Gravel Media
84'
2'
2'
42'
8' center-to-center, max
6' center-to-center, min
To Septic Tank or Pump Chamber
A
A
Montana Department of
Environmental Quality
Scale:
NTS
Evapotranspiration Absorption System - Trench Design
Plan View - Top Cap Removed for Clarity
Dwg. No.
ETA-2


Drainage Fabric
Check Pipe
Topsoil Cap 12" at center
Topsoil Cap - slope for drainage establish vegitative cover
Topsoil Cap 6" at edge
6"
30" max
24"
24"
24"
24"
24"
8' center-to-center max
6' center-to-center min
8' center-to-center max
6' center-to-center min
42'
Check Pipe
Filter Sock
1/4" dia holes
Topsoil Cap
Drainage or Filter Fabric
6"
30"
12"
24"
12"
Filter Media
Montana Department of Environmental Quality
Scale: NTS
Evapotranspiration Absorption System - Trench Design
Section View
Dwg. No. ETA-3


Drainage Fabric
Check Pipe
Topsoil Cap 12" at center
Topsoil Cap - slope for drainage establish vegitative cover
Topsoil Cap 6" at edge
30" max
22"
8' center-to-center max
6' center-to-center min
42'
Topsoil Cap
Drainage or Filter Fabric
6"
30"
Filter Media
22"
12"
Check Pipe
Filter Sock
1/4" dia holes
Montana Department of Environmental Quality
Scale: NTS
Evapotranspiration Absorption System
Section View - Leaching Chamber Design
Dwg. No. ETA-4


Topsoil Cap - slope for drainage establish vegitative cover
Topsoil Cap 6" at edge
6"
30" max
Check Pipe
Topsoil Cap 12" at center
Drainage Fabric
8' center-to-center max
6' center-to-center min
42'
Topsoil Cap
Drainage or Filter Fabric
6"
30"
Filter Media
Check Pipe
Filter Sock
1/4" dia holes
Montana Department of Environmental Quality
Scale: NTS
Evapotranspiration Absorption System - Gravel Media
Section View
Dwg. No. ETA-5

REFERENCES

Environmental Health Programs. October 1990. *Vertical Separation: A Review of Available Scientific Literature and a Listing from Fifteen Other States*. Olympia: Washington State Department of Health.

Puget Sound Water Quality Authority. April 1996. *Guidance Handbook for On-site Sewage System Monitoring Programs in Washington State.* Olympia: Washington State Department of Health.

Soil Survey Division Staff, United States Department of Agriculture. October 1993. *Soil Survey Manual.* Washington D.C.: United States Government Printing Office.

State of Oregon Department of Environmental Quality. April 1995. *Oregon Administrative Rules for On-site Sewage Disposal.* Salem: State of Oregon.

US Environmental Protection Agency. February 2002. *Onsite Wastewater Treatment Systems Manual.* EPA/625/R-00/008. Office of Water, Office of Research and Development, US Environmental Protection Agency. Washington D. C.